CONSUMPTION:

ITS NATURE

CAUSES

AND PREVENTION

BY

EDWARD PLAYTER, M.D.

CONSUMPTION:

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NATURE, CAUSES AND PREVENTION;

WITH AN OUTLINE OF THE

PRINCIPLES OF TREATMENT,

FOR ALL CLASSES OF READERS.

BY

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TORONTO:
WILLIAM BRIGGS,
WESLEY BUILDINGS.

C. W. COATES, Montreal. S. F. HUESTIS, Halifax.

1895

TO THE HONOURABLE

SIR CHARLES TUPPER, BART., G.C.M.G., C.B.,

HIGH COMMISSIONER FOR CANADA IN GREAT BRITAIN, ETC., ETC.,

THIS BOOK IS INSCRIBED

BY

THE AUTHOR,

IN ADMIRATION OF HIS ABILITY AS BOTH A PHYSICIAN ATTAINING THE HIGHEST POSITION IN CANADA, AND AS A STATESMAN, AND ALSO IN RECOGNITION OF THE ASSISTANCE HE WAS CHIEFLY INSTRUMENTAL IN RENDERING TO THE PUBLIC HEALTH INTERESTS OF THE DOMINION BY AIDING IN THE PROMOTION OF HEALTH PROPAGANDA.

PREFACE.

THE object of this book is sufficiently indicated in the title and introductory chapter.

All readers of the book, the author trusts, will kindly overlook the many imperfections in it.

It is not expected that the book will in any way or degree supersede the two or three other works which have been published with a like object. The aspiration is to simply assist in the good work.

While the book is intended for all classes of readers, professional and unprofessional, the author hopes it will be appreciated and largely read by members of the medical profession, who are ever foremost in efforts for promoting the public health, and many of whom, alas! become victims of consumption.

Being apparently the latest of the books published on this subject, and, it is believed, "up to date" in most respects, it may contain something that is in a measure new:—as in relation to the body or soil factor, and also to this being the immediate exciting cause of the disease and the one which it seems desirable and practicable rather to attack first, or with our principal forces, in preventive efforts; to the probable and possible sources, such as that of domestic animals and

that of a possible open air growth, of the other principal causative factor, the tubercle bacillus; and to the nature and degree of the infectiousness, and the *de novo* origin, of the disease.

That the book may be instrumental in preventing human suffering and preserving human health and life is the earnest hope of

THE AUTHOR.

OTTAWA, November, 1895.

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PART I.

NATURE AND CAUSES OF CONSUMPTION.

CHAPTER I.

INTRODUCTORY.

NOMENCLATURE.

In this treatise, it is my purpose to confine myself to that "wasting" disease of the lungs commonly called Consumption (from the Latin word *consumo;* originally, to take the whole of anything—hence to eat, waste away, bring to naught—to consume). The disease is more accurately termed pulmonary consumption—consumption of the lungs (pulmonary, from the Latin, *pulmonis,* a lung). Furthermore, from the peculiar tuber-like or knob-like masses—tubercles—of disease-substance or tissue, which form in the lungs in this disease and which are special characteristics of it, it is yet more accurately and technically termed tubercular pulmonary consumption. Such tubercles, moreover—tubercles of precisely the same history and character—form in many other organs and tissues of the body as well as in the

lungs, especially in the bowels, and hence the term, consumption of the bowels. Hence, too, the technical term, tuberculosis, which is gradually coming more and more into use, particularly with reference to domestic animals. Again, in many cases, two or more or many of the bodily organs become the seat of these tubercles, or of the disease, at the same time, and to these cases we apply the term, "general tuberculosis." Consumption and tuberculosis are in this connection synonymous terms. Phthisis, the Greek word for wasting away, is another technical, classical name commonly given to the disease, especially by physicians.

The term consumption, however, is in most common use, the disease is best and most generally known by that name, and it is therefore my purpose to adhere for the most part to this less technical word. Furthermore, when the word consumption is used herein, unless otherwise designated or explained, it means tubercular pulmonary consumption—consumption of the lungs—this being by far the most common form, the lungs being the most common seat, of the disease.

It will be well to observe here, and for the reader to bear in mind, that, in using means for the prevention of the lung disease we at the same time combat, more or less successfully, all the other forms of consumption.

PREVALENCY AND COST OF THE DISEASE.

Consumption is such a very prevalent and fatal disease in almost every country in the world, in both

man and the domestic animals, that hardly any subject can be of greater importance than that which relates to its prevention. It is a subject which concerns every individual, of every age, high, low, rich and poor, almost alike ; for so wide-spread is the disease that no one is exempt from it or its influences. As Doctor Irving A. Watson (Sec. Am. Pub. Health Assoc., in pamph., Prevent. of Consump.) graphically gives it: "In many geographical divisions of the world it invades almost every community. It comes with such an insidious and silent tread that its footfall is unheard. It seizes its victim with such a gentle and tender grasp that its hand is unfelt till its finger has painted the hectic flush of its first conquest ; and in a few weeks, a few months, or perchance a few years, it has attained its ultimate victory—death. There is no life too pure, no face too sweet, no form too lovely, for its unrequited passion of destruction. It is the crowned king of mortality before whose edict we have too long bowed our heads in ignorant and sometimes reverential submission."

In its various locations in the body, consumption causes from one-seventh to one-fourth, according to climate and locality and the habits and manner of life of the people—probably on the average, one-fifth or more—of all the deaths of the human race, and it has been aptly termed the "Great White Plague." In England, pulmonary (lung) consumption alone still causes about as many deaths every year as did small-pox a century ago, or about one-tenth of the totals. Nearly half a century ago, the late Sir James Clark,

M.D., wrote (Cyc. of Pract. of Med.): "It is not advancing too much to state that, among the whole range of human infirmities, tuberculous diseases are the most deserving the study of the physician, whether we regard their immense frequency or appalling mortality. Confined to no country, age, sex, or condition of life, they destroy a larger proportion of mankind than all other chronic diseases together."

Moreover, with the exception of certain limited localities in England and on the Continent of Europe, of armies and navies and a few public institutions, where from certain or better hygienic regulations and administration in recent years the disease has been less prevalent, it appears to be generally increasing in frequency.

From the usual slow progress of the disease, from the long period of debility, sickness and inability to work, which almost invariably accompany it, the actual money outlay for medical attendance, medicine, nursing, etc., which it calls for—aside from the loss of time and incalculable amount of suffering and the deaths—is vastly greater than that of any other disease.

IT IS COMMUNICABLE AND PREVENTABLE.

Consumption is, in a measure, an infectious or communicable disease; that is, the seeds or germs of it sometimes proceed directly from another person or animal affected with it. This is now almost universally conceded by authorities. Where, therefore, no special measures to prevent its spread are made use

of it is but natural that it should increase in frequency. That it is not virulently or highly infectious, however, is apparent to any observer; and this probably for these reasons: the infective particles or germs are not given off so abundantly from an infected body as in the case of many other infectious diseases; they multiply slowly; they have not such great vitality or virulency as, or they are more easily rendered inert or destroyed by a low or high temperature than, most other germs; and they do not so readily adapt themselves to surrounding conditions, requiring a more especially adapted, receptive, non-resisting soil within the human body in which to develop and grow: just as in ordinary vegetation the seeds of some plants are much less abundant than of others, multiply more slowly, are more easily killed, and will not take root and grow in such soil as the seeds of other plants will readily spring up in and reproduce themselves in abundance. Practically, then, it need not be treated with such extreme preventive or sanitary measures as are necessary in the management of most of our epidemic, infectious diseases.

Consumption is now universally regarded by the medical profession as being preventable, as are more especially all diseases which are infectious, or communicable from one person to another. Moreover, anyone who will examine into its now well-known causes cannot fail to see that it is not only preventable but that it may be more easily and surely prevented than the more actively infectious diseases which prevail epidemically, the prevention of it being

in each case more in the individual's own hands. Many persons, unhappily, even amongst the more intelligent classes, look upon consumption as something to which certain predisposed human beings are so naturally subject that prevention in such cases is impossible; yet, when once symptoms of its presence become manifested in such persons there is usually no hesitation in at once resorting to means for its cure—alas! too often when too late.

It is remarkable, considering the great fatality of this malady, that more general special attention has not heretofore been given by sanitarians to its prevention. Those interested in public health work have bestowed their thoughts and time chiefly on those diseases which prevail epidemically and in a short period of time destroy many lives, while this abiding disease, ever cutting off, after months and years of almost hopeless suffering, vast numbers of lives, often the brightest, most useful, most valuable, frequently in the best period of life, has not received due practical consideration. "Were the annual deaths from this affection to occur in a few days instead of a year, the public would require no urging to be convinced of the absolute need of strictly observing preventive measures" (Burt).

Health authorities from time to time issue pamphlets of instructions on the prevention of diphtheria, small-pox and scarlet fever, but very little in this way has yet been done for the prevention of consumption, a more preventable and more destructive disease. A

commencement in this way, however, has been made and the prospects are improving.

Statistical evidence is not wanting to prove that the mortality from consumption has been largely reduced in certain localities by sanitary or preventive measures, although these measures were not usually specially intended to prevent this disease. For example, according to Doctor Thorne Thorne, Chief Medical Officer of the Local Government Board, of England, in the period 1864-68, the consumption death-rate in England and Wales ranged from 2.602 to 2.336 per million living per annum: whereas, during the period 1884-88, the corresponding rates had fallen to 1.752 and 1.541 per million. This marked diminution, Doctor Thorne says, though doubtless in part a matter of nomenclature—of recognizing and more correctly naming lung diseases—"has without question been largely assisted by the improvements that have taken place in the general conditions affecting the population"—improvements in lodgement, employment, feeding and clothing, more out-door exercises in the young—"and a number of other matters which have gone to diminish a tendency to catarrhal maladies, the aggravated recurrence of which tends to induce a condition favorable to the development of pulmonary tubercle." Again, in the army and navy, by providing more space per man in housing or barracks and better ventilation, the proportion of deaths from the disease amongst the men has been thereby greatly reduced.

Now, it will be well to note here, at once, that, in the prevention of consumption, there are

TWO PRIME ESSENTIAL CAUSES

or conditions which must always be taken into consideration: namely, (1) the germ or *seed*, the infection; and (2) the special, fit *soil*, the receptive non-resisting body, in which only the seed can grow.

While it appears clear that no soil, no condition of the human body, however fitting, can give rise to tubercular consumption until the special seed—the infective germ—has been sown or has fallen or found its way on to it, any more than the most suitable soil can produce thistles or mustard without the seeds of these plants, neither can the infection or seed of this disease develop and grow and give rise to the disease unless it find or fall upon the special, as it were prepared, soil or condition of body. This is a most important point to bear in mind in all efforts for the prevention of the disease.

CURABILITY OF CONSUMPTION.

While the prevention of the disease should be the first aim, it should be remembered that consumption is curable as well as preventable—curable in its earlier stages. Of this there is abundant convincing evidence. Some persons are cured of it in general medical practice, after it had been clearly "seated;" while many hospital patients who died of other diseases have given unmistakable evidence, on *post-mortem* examination, that they had had the disease, although it had long before ceased to be progressive and the scars alone were left. Most of the patients, so far as could be learned from their history, never

knew that they had had it. The cure had been, perhaps, brought about simply by a change on the part of the individual from an in-door life to an active one out in the pure air and sunshine. It is, therefore, a mistake to regard those who have contracted the disease as being necessarily doomed to die of it sooner or later and all treatment as only palliative.

There is not, however, it may be here clearly and positively stated, any specific for the cure of consumption, all the promises of charlatans, as through misleading advertisements in papers or otherwise, to the contrary notwithstanding. The treatment of it by the best physicians is on general principles, in accordance with the particular condition of each individual case, no two being precisely alike; indeed, it is almost entirely of a hygienic character, as it is termed, consisting mainly of such means as, when early employed, prevent the development of the disease.

KNOWLEDGE OF BREATHING NECESSARY.

In order that consumption may be most successfully combated and prevented, it is essential that every person should know something about the nature, character and causes of the disease, and therefore something, too, about the structure and functions of the lungs and the nature of respiration—the function of breathing.

Nearly all consumptives, if not all, have a proportionately small or limited respiratory capacity or action—proportionately small lungs, perhaps, from heredity, or if not small, the use of them is limited

from habits of life; hence the function of respiration in these persons is but imperfectly performed. Much of this is from ignorance. Few know the nature or importance of this function.

Breathing we may regard as the most vital and important of all the functions of the body. It is, therefore, most desirable that every body should know how to breathe properly. Many persons do not know. It will then be best to devote a few pages here to a brief description of the lungs and their uses. A little knowledge is a "dangerous thing" *only* to those who presume too much on that little, who do not use it properly but misuse it.

CHAPTER II.

THE LUNGS AND THEIR FUNCTIONS, OR USES.

WHAT IS RESPIRATION?

RESPIRATION (from the Latin prefix, *re*, and *spirare*, to breathe—*i.e.*, to breathe again) is that function by which an interchange of gaseous substances takes place between the inner parts of a living body and the air or water in which it lives. Animal bodies take in oxygen and give out carbonic acid gas: vegetable bodies take in carbonic acid gas and give out oxygen. In the higher animals the special organs for this interchange of gases are the lungs; in fishes, the gills; in plants, the leaves. As through the stomach the food eaten gets into the blood, so through the lungs, oxygen—gaseous food—gets into the blood. But the lungs are something more than nutrient organs; they are largely excretory organs, too, for throwing off waste matters.

A lung is simply a broad, yet much folded, very fine, delicately constructed, transparent membrane, with one surface exposed to the air in the lungs, while the blood in minute vessels is spread out on the other. So broad is this membrane that it is said, if it were spread out its surface would be thirty times that of the skin of the body. Gases pass readily through it,

just as air passes through fine muslin: and the oxygen of the air in the lungs passes through it into the blood, while at the same time carbonic acid and other substances from the blood pass out and are expelled.

Out-door atmospheric air consists of about 21 per cent. of volume of oxygen, and seventy-nine of nitrogen, with varying proportions of watery vapor, less than a two-thousandth part of carbonic acid gas, and mere traces of ammonia and other gases. The maintenance of the higher animal life depends upon and necessitates a continual taking in or absorption from the air of oxygen and a small proportion of nitrogen, and a throwing off or excretion into the air of carbonic acid, with watery vapor and a poisonous nitrogenous vapor. The object of respiration is the interchange of these substances between the blood and the outer atmosphere. The lungs—the special organs of respiration, are most wonderfully and beautifully constructed for exposing the blood to the atmosphere in order that such interchange may take place. The blood, after it has circulated for a few moments throughout the entire body, or has been the round of the greater circulation, is pumped to the lungs, and it is necessary that the atmospheric air with its oxygen shall flow freely, abundantly, through the lungs—into them and out of them—to meet there the blood spread out to be bathed and purified by the air.

If this remarkable process by which we take into the body atmospheric air with its indispensable life-giving oxygen, and throw off out of the body carbonic

acid and other poisonous excrete matters, be suspended, life is almost at once extinguished. If, indeed, the process be even interfered with, and not properly and completely carried on, the other vital processes are soon obstructed and retarded, all the functions of life are impaired, and want of stamina, general debility and ill-health quickly follow.

THE RESPIRATORY ORGANS—THE LUNGS.

The lungs are made up, then, of two vast membranes—one for each lung—so folded or puckered as to form minute cavities, called air cells or air chambers, giving great expanse of surface while yet occupying as little space as possible consistent with their function. Little tubes, called bronchial tubes, lead to these little cells or chambers from larger tubes which extend from the wind-pipe—or trachea, for conveying air into the chambers. The air chambers are of various irregular forms, from mutual compression or packing together, and each is covered with a close net-work of minute blood vessels, called capillaries, so that the blood is on the outer surface of the air chambers, while the air is within them. The air chambers cluster around the little tubes and branch tubes, somewhat like grapes upon their stems. They are so small as to be hardly distinguishable by the unaided eye. Arteries and veins, extending along beside the bronchial tubes, branching again and again, as the tubes branch, convey the blood to and fro between the blood capillaries on the air chambers and the heart. The two lungs,

with the heart and other large vessels, fill the chest. Each lung is somewhat cone-shaped, with the small end terminating in a thin edge, called the apex of the lung, situated behind and a little above the collar-bone, or clavicle.

After air once enters the lungs at birth they always contain some air, feel spongy or elastic on pressure, and will float on water; hence, the vulgar name, "lights." The membrane forming the air chambers is elastic and will stretch considerably, as one will find on blowing into the lungs of a small animal.

THE AIR TUBES AND CILIA.

The windpipe, or trachea, is a stiff tube, containing rings of cartilage which resist pressure and prevent closure of the air passage. Below, it divides into two large bronchial tubes, one for each lung, the right and left bronchi. These divide and divide into smaller and smaller tubes, which extend to all the air chambers. Above, near the throat, the trachea swells out into a larger tube, or sort of box, called the larynx, which contains the vocal apparatus.

All the air passages—the windpipe, and large and small bronchial tubes—and also the air chambers, are lined on the inner or air surface with a layer of minute cells, called epithelium. This epithelial layer is somewhat similar in structure to the cutis—the outer layer of the skin; but instead of being dry, like the cutis, it is moist and soft like that lining the mouth. Like the cutis, it is gradually shed or worn off and renewed. On the free surface of it, extending

from the larynx to and throughout the smallest bronchial tubes, though not into the air chambers, are most minute, hair-like processes, set closely together, called cilia. They are about 1-5,000 of an inch long, one end being free while the other is attached to the layer of cells or epithelium, resembling in their arrangement the pile of velvet. The cilia are in incessant vibratory motion, which, under the microscope, gives to the eye of an observer an impression similar to that given by the surface of a field of ripening wheat when moved by the wind. These movements produce a continued current outward, and thus foreign substances, as particles of dust, or excess of mucus, as when one has a "cold," coming in contact with the cilia are conveyed from the deeper parts of the lungs to the windpipe to be coughed up.

THE CHEST WALLS AND PLEURA.

The walls of the chest are formed chiefly by the ribs, with two layers of muscular fibres, the intercostal muscles, stretching between each pair, for the purpose of moving them. The ribs are attached behind to the spine, each by a movable joint, and as one may see by examining one's own ribs or those of another person, they are considerably lower in front than at the spine, so that when the front ends are raised by the muscles, the breast bone, or sternum, is lifted and moved forward, and thus the depth of the chest is increased. The breadth of the chest is at the same time increased by the rotatory elevation of the central part of the ribs, at the sides, somewhat as the half-circle

handle of an ordinary wooden bucket is raised. The floor of the chest, dividing it from the belly, or abdomen, is formed by a broad, thinnish, but strong muscle, the diaphragm, which curves up dome-like into the chest. When its fibres contract, it becomes flatter and presses downward the contents of the abdomen, as one can feel by placing one's hand on the stomach when drawing in air, and the height or length of the chest is thereby increased. Thus the depth, breadth and length of the chest are increased, and by muscular action.

The atmosphere always pressing on everything pours into every crack or opening. The chest is an air-tight chamber, and air cannot get in between its walls and the lungs. When the ribs are raised, the diaphragm depressed and the chest thus enlarged, air enters the lungs freely through the ever-open nostrils, throat and windpipe, and they are kept stretched against the chest walls and always just fill the chamber. The walls of the chest keep the air pressure from the outside of the lungs, and so these organs are kept expanded by the air pressure on the inside of them. If an accidental opening be made through the walls of the chest, and especially if one be made on each side, as by stabs, air enters in between the chest walls and the lungs, and sometimes so compresses them as to make breathing difficult, or quite impossible and suffocation follows.

Between the walls of the chest and the lung, on each side, entirely investing the lung, is a delicate serous membrane having a double layer, one of which

is spread over and attached to the lung, forming its smooth, slippery covering, the other over the chest walls. This, like all such membranes, forms a great closed, irregular-shaped sack with the inner, opposed but unattached surfaces very smooth, and on which is a little lubricating fluid that prevents friction during the movements of the parts on each other in the acts of breathing. This membrane is called the pleura, and an inflammation of it is what is termed pleurisy.

THE BREATHING ACTS AND LUNG CAPACITY.

Breathing consists of two acts: first, that of raising the ribs, increasing the size of the chest and permitting air to flow into the lungs; and, second, that of lowering the ribs, lessening the size of the chest, and forcing the air out again. The size of the chest, remember, is increased in all dimensions—depth, breadth and length; the ribs are raised, chiefly by the outer layer of the intercostal muscles, making the chest deeper and broader; the diaphragm is flattened or drawn down by the contraction of its fibres, making the chest longer; and air rushes through the windpipe into the lungs, keeping them pressed close to the walls of the chest. This is inspiration. The outer intercostal muscles and diaphragm now cease to contract, the ribs are drawn down again, chiefly by the inner intercostals, and the diaphragm again rises up into the chest, helped up by the contents of the abdomen, which are pressed upon by the muscular walls of that cavity, and the stretched lungs return to their former size again. This is expiration. We breathe

thus from fourteen to twenty times every minute; from fourteen to twenty times every minute the ribs rise and the diaphragm descends, and then both return to their former state again.

The quantity of air drawn into the lungs at each breath is small when compared with the quantity they will hold. The lungs are not nearly filled to their greatest capacity, nor nearly emptied, at each breath. In a condition of full development and health, therefore, these organs have not only a sufficient breathing surface for performing their ordinary functions, but also sufficient to meet any extra demand, within reasonable limits, that may be made upon them. The lungs of a full-sized man will hold, when stretched to their utmost, about or over three hundred cubic inches of air. But after an ordinary inspiration they actually contain only about two hundred cubic inches, remember, or two-thirds of what may be drawn into them by a forced inspiration. Now, barely one-seventh of this, on an average, or twenty-five to thirty cubic inches, is pumped in and out at each respiratory act. After an ordinary expiration, therefore, the lungs still contain probably one hundred and seventy-five cubic inches of air. In other words, every time we breathe we change only about one-seventh of the usual air contents of the lungs. This one-seventh of the air contents of the lungs which we pump in and out with every breath is called breathing or tidal air. The quantity of air over and above the ordinary tidal air which can be drawn in by a deep or forced inspiration is called complemental

air, the amount of which varies greatly in different individuals. The air remaining in the lungs after each ordinary expiration of the tidal air—that is, the other sixth-sevenths of the ordinary lung contents—is called stationary air. By a greatly forced expiration about one-half or more of this stationary air can be expelled. This is called reserve air. After this, after the greatest expiratory effort, a certain amount of air still remains in the lungs—air which cannot be expelled by any effort. This is called residual air, and its amount depends largely on the size of the chest; but it is estimated at from fifty to one hundred cubic inches.

Respiratory capacity, the vital capacity of Hutchinson, represents the quantity of air which can be expelled from the lungs by the most prolonged expiration possible after the deepest inspiration possible. It represents the power of a person to draw air into the lungs, and is measured by an instrument called a spirometer, into which the person breathes. The vital capacity, the quantity of air expelled, is indicated by the height to which the air chamber of the spirometer can be raised by the forced expiration of the experimenter. It expresses the person's breathing power in emergencies, as in active exercise, etc.

The average lung capacity of a healthy adult man, five feet seven inches in height, is about 225 cubic inches. For every inch of stature above this standard the capacity is found to average about eight cubic inches more; and for every inch below, eight cubic inches less. The influence of weight on the

capacity is less manifest. It appears to decrease in weights above 160 pounds. "By age, the capacity appears to be increased from about the fifteenth to the thirty-fifth year, at the rate of five cubic inches per year: from thirty-five to sixty-five, it diminishes at the rate of about one and a half cubic inches per year; so that the capacity of respiration of a man sixty years old would be about thirty cubic inches less than that of a man forty years old, of the same height and weight" (Hutchinson). "Bourgery calculates that a child of ten years of age, with a weight three times less than that of a man of eighty, has a respiratory power eight times greater, due to the great difference in the range of respiratory movements. The old man is able to increase the usual amount breathed by less than one-half, while the child may increase it nearly fourteen-fold." The capacity of the lungs, it appears, is much smaller in females than in males. The force which can be manifested by the expiratory act is, on the average, a third greater than that of the inspiratory act.

There is, then, it must be remembered, usually a large amount of stationary air (reserve and residual air) in the lungs. How does the tidal air get down deep into the air chambers and reach the blood?

THE BLOOD AND THE BREATH IN THE LUNGS.

Gases diffuse and mix rapidly. If a jar be filled with one sort of gas and turned mouth downward over a jar filled with another sort of gas, the gases immediately commence to mingle together, and in a

short time both jars will be filled with the thoroughly mixed gases. The mixture takes place rapidly and against gravity. It is constantly going on in the lungs. The tidal air we draw in at each breath quickly mingles with the stationary air already in the lungs, and the few cubic inches of air we almost immediately expel by expiration is not the same we had just drawn in by inspiration, but a mixture of tidal and stationary air; a seventh of it only, probably, being of that just breathed in.

The blood in the lungs, as it moves along in the minute vessels covering the air chambers—the lung capillaries, is thus constantly bathed with air, which is partly renewed and purified at every breath. As often as once every minute, it appears, all the blood in the body flows through the little vessels on the walls of the air chambers, so numerous are they. Blood, before it passes over the air chambers, is dark purple, and is called venous blood. It has been the round of the circulation—to all parts of the body, and has taken in a lot of waste matters, chiefly in the form of carbonic acid, watery vapor and a poisonous nitrogenous substance, the carbonic acid making it dark. In this condition it flows along the veins (hence the name venous) to the heart, whence it is forced on to the lungs. While flowing through the lungs, the blood gives off to the air in the little air chambers its burden of waste stuffs, and takes up from the air in the chambers a load of oxygen, and becomes again of a bright red tint—arterial blood. Thus purified and replenished with oxygen, it flows back to the heart,

whence it is again pumped along the arteries to all parts of the body. It now trickles through the short capillaries in the tissues into the veins once more for another trip to the heart. While in the tissues it discharges its oxygen and is loaded with tissue waste. The oxygen in the blood is carried by the red coloring matter (hæmoglobin) of the red corpuscles. Magnus has shown that "venous blood contains 25 per cent. of its volume of carbonic acid, and 5 per cent. of oxygen; and that arterial blood, on the other hand, contains as much as 10 per cent. of oxygen, and only 23 per cent. of carbonic acid."

The lungs then perform a double function. They take in the oxygen which the organism requires, and which, because it is so essential to life, has been called vital air; and they cast out a large proportion of the worn-out waste matters of the body, the products of tissue wear and combustion, which, if retained in the blood, would soon destroy life.

Furthermore, full breathing promotes the circulation of the blood, not only through the lungs but throughout the entire body, aiding in general nutrition.

THE POISONS IN BREATHED AIR.

Expired or breathed air contains, then, a large excess of carbonic acid and watery vapor, and perhaps most important of all, from a health standpoint, the organic poison, or leucomaine, and much less oxygen than ordinary air. While ordinary atmospheric air contains about twenty-one volumes per cent. of oxygen and .035 per cent. (about 1-30 of 1 per cent.) of

carbonic acid, expired air contains only about 16 per cent. of oxygen, and fully 4 per cent. of carbonic acid, or nearly 120 times as much more carbonic acid as atmospheric air. A man consumes about twelve or thirteen cubic feet of oxygen every twenty-four hours, and throws off, by the lungs, in the same period of time, over sixteen cubic feet of carbonic acid—equal to about eight ounces of solid carbon—and from twenty to forty ounces of water, in the form of vapor.

If a wineglassful of limewater be put in a half-pint bottle, and the breath blown two or three times into the bottle, on shaking it the limewater will become quite milky from the formation of insoluble carbonate of lime (carbonic acid gas and lime combined), which after a little time will settle on the bottom of the bottle. Every breath contains a good deal of moisture, too, as proved when one breathes on a cold mirror. In cold weather we breathe more air and oxygen, and give off more carbonic acid, than in warm weather, as we do likewise when taking exercise.

The organic matter in expired air is a most important ingredient. It has a disagreeable smell, and is very poisonous to rebreathe. The fetid odor in unventilated bedrooms and crowded rooms is owing to this impurity. It is nitrogenous, yielding ammonia on decomposition, is but slowly oxidized, and seems to float in clouds like tobacco smoke. It is most readily absorbed by wool, feathers, and damp walls, and has been found in large quantities in the plaster

removed from the walls of hospital wards. The bare thought of inhaling, drawing into our body, this excrete poisonous substance from the lungs of another person, or even from one's own, is very repulsive. Yet it is, with the other exhalations from the lungs, almost constantly and universally breathed by all classes in-doors. In the open air, or in well-ventilated rooms, these substances are soon dissipated and rendered innoxious by free dilution with the air and by oxidation.

POISONOUS EFFECTS OF PREBREATHED AIR.

When the waste substances above mentioned are not sufficiently thrown off by the lungs, but accumulate in the blood, as always is the case when respiration is imperfectly performed, they are certain to prove highly injurious. When, for example, the air breathed contains a great excess of carbonic acid, as in the case of breathing air which has been once breathed, then the quantity of carbonic acid exhaled from the lungs is much less than usual, much of it, as well as of the poisonous organic matter, remaining in the blood. So it is likewise when the breathing acts are shallow and imperfect.

The total quantity of air which flows through—that is, into and out of—the lungs of an adult person when at rest, every hour, is about 28,000 cubic inches, or 700,000 cubic inches—400 cubic feet—in twenty-four hours: representing a cube of about seven and a half feet, or the full of an apartment seven and a half feet in each of its dimensions. A

man engaged in hard work will breathe more than double this, or an amount equal to the contents of a room ten feet square on the floor and eight high.

It is found that in a room crowded with people many persons suffer from headache, dizziness and even nausea, when the carbonic acid in the atmosphere of the room reaches one-seventh of 1 per cent.: the effects being due doubtless to the presence of the organic vapor or effluvia from the lungs and the diminution of oxygen, as well as, or more than, to the presence of carbonic acid. According to Parkes, when the carbonic acid in such an atmosphere reaches to one-half this amount, or one-fourteenth of 1 per cent., the organic effluvia is distinctly perceptible to the sense of smell of most persons. A man at work in a close room of the size above mentioned (ten feet by ten and eight feet high) exhaling, with every breath of his one thousand breaths an hour, air containing over 4 per. cent. of carbonic acid, would, therefore, in less than one hour, render the air in the room so foul as to cause headache, dizziness, etc., in many persons. From experiments of Doctor Snow upon animals, he concludes that "5 or 6 per cent. by volume of carbonic acid cannot exist in the air without danger to human life, and that less than half this amount will soon be fatal when it is formed at the expense of the oxygen of the air," as in respiration. So that a man working in such a room, if it were absolutely "air-tight," would not be likely to survive twenty-four hours. Fortunately rooms are never air-tight, though many persons endeavor to make those they live in as nearly so as possible.

THE OXYGEN IN THE BODY.

The uses of all the atmospheric oxygen, as taken in by the red corpuscles—nearly a fourth part of that drawn in at every breath—is not yet positively known. Nearly all of it, however, enters into ready combination with the carbon and hydrogen of the tissues, in that tissue-change—that breaking down or "wear" (destructive metabolism)—which is essential to life: protoplasm constantly being formed of the food supply going to build up again (constructive metabolism). This combination of oxygen with carbon and hydrogen in the tissues, at the same time, produces the heat by which the body is kept warm; just as heat is produced outside the body. The products of the combination, then, carbonic acid and water (oxygen and hydrogen), are readily conveyed to the lungs and thrown off, eventually into the outer air. Probably some of the oxygen unites directly with the carbon and hydrogen of the food. A portion doubtless acts as an oxidizer of any poisonous products in the body. It appears to act, indeed, practically as the great purifier of the organism.

The distribution of non-oxygenized blood over the body is "incompatible with life for more than a few minutes; the rapidity with which death ensues in asphyxia being due, more particularly, to the effect of non-oxygenized blood on the medulla oblongata, and, through the coronary arteries, on the muscular substances of the heart. The excitability of both nervous and muscular tissue is dependent on a constant and large supply of oxygen, and when this is inter-

fered with, is rapidly lost. The diminution of oxygen has a more direct influence in the production of the usual symptoms of asphyxia (suffocation) than the increased amount of carbonic acid" (Kirk's Phys.).

THE FOLLOWING IMPORTANT FACTS

may be summarized here with advantage. Our habits of life, our daily practice, should be in accordance with them.

Air once breathed contains nearly a fourth less oxygen than atmospheric air, and hence is quite inadequate for the purposes of respiration—unfitted to be breathed again, or to sustain life.

Out of doors, in the momentary pause after expiration, the air just exhaled is usually at once changed—renewed, before another breath is taken. In very calm, "close" weather, fans are instinctively used in a measure for dissipating the breath.

Air once breathed contains, besides the poisonous organic effluvia and much moisture, above 4 per cent. of carbonic acid, or 120 times as much as pure atmospheric air.

When respiration is not perfectly performed—when the air breathed is not pure, or the lungs are not habitually fully distended and used—poisonous waste matters are retained and accumulate in the blood, causing derangement and disease.

It will now be easy for the reader to understand how very essential it is that only pure, fresh air be breathed, and that it be breathed not sparingly; how essential, for both dwelling-places and the lungs, is free ventilation.

PROPORTIONATE CHEST DIMENSIONS.

For perfect respiration, well-developed lungs, of a size proportionate to that of the other organs of the body, are indispensable, and the lungs must be exercised and used in a rational manner. Many persons with well-developed lungs do not use them as they should—fully and freely.

In the structure of almost everyone there is, from hereditary and other influences, a want, small or greater, of due relative proportion in the various organs of the body, some organs not being so well developed as others. It may be the stomach, or the heart, the lungs or the brain, which is defective, and hence the weaker organ. It is very desirable for every person to know the weaker parts.

As regards the lungs, the dimensions given in the following table show the circumference of the chest of well-developed, vigorous persons of the respective height and weight given. The size of the chest furnishes a correct index of the size of the lungs, as these organs with the heart and its large vessels just fill this cavity.

HEIGHT OF INDIVIDUAL.	CIRCUMFERENCE OF CHEST ON A LEVEL WITH NIPPLE.		AVERAGE WEIGHT.
	MEDIUM.	MAXIMUM.	
5 feet 1 inches	34.06 inches	40.66 inches	120 lbs.
5 " 2 "	35.13 "	41.33 "	125 "
5 " 3 "	35 70 "	42.00 "	130 "
5 " 4 "	36.26 "	42.66 "	135 "
5 " 5 "	36.83 "	43.33 "	140 "
5 " 6 "	37.50 "	44.00 "	143 "
5 " 7 "	38.16 "	44.66 "	145 "
5 " 8 "	38.53 "	45.33 "	148 "
5 " 9 "	39.10 "	46.00 "	155 "
5 " 10 "	39.66 "	46.66 "	160 "
5 " 11 "	40.23 "	47.33 "	165 "
6 " 0 "	40.80 "	48.00 "	170 "

With the lungs proportioned about as above indicated, habitually exercised to the full requirements of the body, and taking in only fresh, pure air, the function of respiration is almost certain to be perfectly performed, and consumption prevented.

THE LUNGS MAY BE ENLARGED.

It must not be supposed that for persons born with proportionately small lungs there is no remedy. The size of the chest and lungs may be very materially increased, just as an extremity, the arm or leg, may be increased by judicious exercise.

Imperfect respiratory action is very common. The movements of the lungs and walls of the chest have their origin in, and are controlled by, nervous influence. Breathing is not a voluntary, but an involuntary act. We breathe without knowing it: but breathe we must. We can breathe quicker or slower, take long breaths or short ones, but we cannot by any unaided effort of the will stop the breathing. From imperfect nervous development, however, or derangement of the nervous system, from habit or want of active exercise, many persons do not commonly, perhaps never, fill and distend their lungs to the full requisite extent. In such circumstances, not only is the whole function of respiration imperfectly performed, but the almost unused parts of the lungs, the distant parts—the extreme upper edges, or apexes, especially—become weakened and eventually diseased, as any part of the body, an arm, for example, would, if it were not used for a long time. Consumption usually commences in the apexes. The remedy is obvious, and in the hands of the persons themselves.

CHAPTER III.

NATURE AND CHARACTERISTICS OF TUBERCULAR PULMONARY CONSUMPTION. WHAT IS CONSUMPTION?

ITS DIFFERENT FORMS AND NAMES.

Consumption is particularly characterized by the formation in the lungs of what is called tubercular matter, or "tubercles," with destruction or wasting of the lung tissues, usually with insidious commencement and slow progress.

The disease has been known by different names. In the human body it has been long commonly called consumption—wasting, "pining" or "decline." In the lower animals it has been known as the "grapes" or "pearl disease," and sometimes the animal has been called a "waster." The diseased conditions long recognized by these various names and believed to be different are now known to be one and the same.

Three forms of pulmonary consumption are sometimes described by authors—the catarrhal, the fibroid and the tubercular, apparently in accordance with the respective feature which is most predominant: whether more catarrhal in character, or more fibrous, or more abundantly tuberculous. At any rate, the catarrhal and fibrous forms are not common, and in

the earlier stages, appear to be usually but diseased states of the lung tissues of a non-specific character, by which the tissues are brought into a condition more suitable for the growth of the characteristic formation—the tubercle—of true tubercular pulmonary consumption. There are occasional cases of the fibroid form in which, from an excessive formation in the lungs of fibrous tissue, these organs become more or less solidified and their functions proportionately destroyed, and in which the symptoms resemble those of the true tubercular disease, but in which no tubercles are found. Some authorities contend that these are not tuberculous. One of the best of them, however, R. Douglas Powell, M.D. (Ætiol. of Phth.: Dis. of the Lungs), has quite recently written,—"Further experience has led me strongly to doubt whether in all cases of fibroid phthisis tubercle does not take an essential part." Practically, the catarrhal and fibroid forms need not be further noticed here.

WHAT IS TUBERCLE ?

Now, what is this peculiar substance, tubercle? When first or recently formed in the body tissues, or as found resting sessile on tissue, often "standing out distinctly," it is a little pearl-like mass, usually rounded where separated from others, and varying in size from a minute speck to that of a small shot. It is somewhat sticky, tough, and difficult to crush or tear. At first it is greyish-white and semi-transparent, but later it becomes slightly yellowish and opaque. These little

masses, especially when numerous and scattered, from being usually about the size of a millet seed, have been called "miliary tubercle." By their pearly appearance, the name "pearl disease," in bovine animals, was suggested. Sometimes a number of these little tubercles are found in a cluster. Masses the size of a walnut or larger are often formed by the aggregation of the smaller ones. So numerous and enlarged do these growths sometimes become in bovine animals that the lungs are thereby increased to thrice or even five times their natural weight, to from forty and even sixty pounds. Tubercle has never been found except in warm-blooded animals.

THE TUBERCLE BACILLUS.

What is the cause of the formation of tubercle? Whence comes it? For thousands of years these questions could not be answered. For only about half a century now it has been known that tubercle could be newly developed in certain susceptible animals by inoculating them with tubercular matter which had developed in another animal. It appears that Buhl, in 1857, demonstrated the fact that it was invariably due to the existence of it or its products in some other part of the body; and Villemen, in 1865, made its specific nature still more conclusive by repeatedly producing tubercles in unaffected animals by inoculating them with tubercular matter. It was only in 1882, however, that Doctor Robert Koch clearly demonstrated that one immediate, essential and what is now usually regarded as the directly exciting

cause of the tubercle formation is a living microscopic fungus, akin to those which form moulds and to the germs of other infectious diseases, a species of bacillus (Latin, baculum: Greek, baktron; a stick or staff), and a variety of bacterium. It is a "parasitic" (so-called) vegetal organism of the lowest or simplest form of life, now termed the *bacillus tuberculosis* (bacillus of tubercle or tubercle bacillus; in the plural, bacilli), or bacillus of Koch. Each bacillus is from 1-12,000 to 1-8,000 of an inch in length, less than half the diameter of a red blood-corpuscle, or blood-cell, with a thickness of about one-fifth or one-fourth of its length. It is usually slightly curved or bent, with somewhat rounded ends. It has no motion, and is said to exist "better where there is no oxygen"—facultative anærobic (M. V. Ball, M.D.: Essent. of Bact.). At a temperature of 86° F. it grows, it appears, but slowly; and it will not continue to propagate in decomposing fluids or in the presence of bacteria of more rapid or more vigorous growth (in the laboratory). By direct sunlight its vitality has been apparently destroyed in two or three hours, while it is destroyed in a few minutes by a moist temperature of 128° F. In a dry state, however, as in sputum or spittle, its vitality may be preserved for months.

LABORATORY CULTIVATION OF THE BACILLUS.

Although tubercle cannot develop except in a warm-blooded animal, living cells being essential for its development, the tubercle bacillus can be cultivated

in the laboratory. If a little of the serum (the watery part) of ox-blood or other certain prepared liquid be placed in a test tube (a long, narrow sort of bottle of thin glass), and sterilized by heat to destroy any bacteria it may contain, the mouth of the tube being plugged with sterilized cotton wool to strain the air and keep out other bacteria, and if when the culture material—the serum—becomes solid, a minute particle of fresh tubercular matter be carefully placed on it, and the whole kept at blood temperature, or about 100° F., in twelve or fifteen days there may be seen around the tubercular matter a few minute, very thin, lustreless, greyish-white, scale-like particles. These consist of colonies of the tubercle bacillus, which had grown there from germs in the particle of tubercle planted. Under the microscope they are seen to be composed of "many very fine lines containing the bacilli." The mass "sometimes looks like crumbs of bread moistened." A Klatsch preparation under the microscope shows "a thick, curled-up centre, around which threads are wound in all directions, the fine lines showing the bacilli in profusion" (Ball). Again, if a little bit of one of these scaly particles be selected and placed on a culture material in another test tube and treated in the same way as the first, in another twelve or fifteen days numerous scale-like colonies of bacilli will have again grown up around the planted "seed." After repeating this transplanting process a hundred times—cultivating a hundred generations—the bacilli not only preserve their characteristics, but a purer cultivation or quality is

obtained. They can be cultivated in air-tight tubes on sliced potato.

When pure bacilli are inoculated into the body of a susceptible animal, tubercles form in it, beginning their growth at the point of inoculation, spreading along the course of the lymphatic vessels, and causing the characteristic symptoms of tubercular disease. The same result follows when the animal is inoculated with a particle of tubercular matter from the expectoration or spittle of a consumptive person, in which the bacilli usually exist in great abundance: and, also, as sometimes unfortunately happens, when a finger is accidentally wounded, and so inoculated, in making a *post-mortem* examination of a tuberculous body of either man or one of the lower animals.

SPORING AND MULTIPLICATION.

Under a high magnifying power, the tubercle bacillus sometimes presents to the view oval spaces at intervals within the rod, giving a dotted or beaded appearance, indicating the production of, or breaking up into, spores: after the manner of moulds and mosses; by which, it need hardly be said, these low forms of vegetation multiply themselves, and also resist influences, such as heat and cold, which destroy the parent plant. That this bacillus is a sporing organism, although not quite satisfactorily established under the microscope, can hardly be doubted. In order to perpetuate itself it must, it would seem, produce some smaller, more resistant bodies, practically spores—something analogous to or corresponding

with the seeds of the higher plants. According to Solles and others, if a rabbit be inoculated with a portion of an old, non-progressing, dried-up mass of tubercle, as from the apex of the lung of a person who had had consumption and was practically cured, and in which no bacilli can be found, the animal will probably die of tuberculosis, and in the tubercles formed in it, numerous bacilli may be found. The bacilli had dried up and disappeared from the tubercular mass used for inoculation, but left, evidently, their seeds or spores. Doctor Douglas Powell (as before cited) says, "It is difficult to escape the conclusion" that such matter contains "abundant tubercular spores, as yet undeveloped and unrecognizable." The bacillus multiplies also by division, or fission,—a method of asexual reproduction common amongst these low organisms. Each bacillus undergoes cleavage crosswise into two equal parts, which then become two independent organisms. That spores are more difficult to destroy by disinfection than the parent plant is an important point to bear in mind in the practice of preventive measures.

RELATIONS OF THE BACILLUS TO THE DISEASE.

Very few authorities now question the correctness of what is termed Koch's theory :—that without the tubercle bacillus there is no true tubercular matter. But it is not yet clearly known whether the peculiar symptoms, local and general, of tubercular or consumptive diseases are caused simply by (1) the constant irritation set up by the local growth and multi-

plication of the bacilli in their parasitic or saprophytic life, a local inflammatory action; or whether they are caused by (2) the formation or excretion by or from the micro-organism of a substance having a poisonous effect upon the tissues invaded: or whether by (3) the microbes causing in their life action such chemical changes or fermentations in the tissues or fluids as to give rise in this way to a poison, causing, in either case, toxic effects upon the entire body. Possibly the symptoms are caused in a measure by each and all of the three ways. It is known that the bacilli, in certain conditions, do give rise to a poisonous product. The constant local inflammatory action set up simply by the presence and multiplication of the micro-organism, as a foreign body, however, would seem to be enough to cause the symptoms in the previously deranged and depressed, if not diseased, body of the host.

However the symptoms may be produced, it seems to be generally believed by the highest authorities that a case of tubercular disease, or consumption, of any kind, will not develop without this bacillus or its spores, any more than a stalk of wheat or corn will spring up without the seed or germ-grain in the soil. Doctor Janeway, of New York, says (Discuss. N.Y. Acad. of Med., Jan. '91), "There are to-day only a few physicians who hesitate to accept the bacillus tuberculosis as the direct exciting cause of tubercular phthisis." And Doctor J. West Roosevelt (Phys. Roosevelt and Bellev. Hosp. N.Y., at ann. meet. Assoc. Am. Phys.) says, "There is no need at this time and

in the presence of this audience to state that, without the presence of Koch's bacillus, there is no tuberculosis. Possibly the statement that without tuberculosis there is no phthisis might not yet be so generally admitted, though it is probably true. . . . Consumption, whether called 'catarrhal' or 'tubercular phthisis' or by any other name, has as part of its lesion [diseased condition] newly formed tissue containing the bacillus tuberculosis of Koch."

WHENCE COMES THE TUBERCLE BACILLUS?

The special characteristic feature then of consumption is the growth or formation in the lungs of a peculiar substance called tubercle, an absolutely essential factor in the formation of which, or an essential cause of which, is the tubercle bacillus. Now whence, it may be here asked, comes this bacillus? As above observed, it exists in abundance in the expectorated matter from the lungs of consumptive persons, and it can be cultivated in the laboratory. Koch's view appears still to be that it is a "true parasite" and cannot live outside the body of its host: and that it will thrive and multiply only at a temperature ranging from about 95° to 105° F. Hence it is inferred that it can only come from another case of the disease in man or the lower animals. It is to be regretted that the more natural or botanical characteristic features of this bacillus, as well as of other disease germs, indeed, have not been more specially and deeply studied, along with its laboratory or other characteristics. It seems possible that it may flourish

outside a living animal body, and may be akin to so-called "malarial" organisms. It is well known that other germs—as the bacillus of "splenic fever," for example, in its natural state—flourish and "complete their developmental cycle," as Koch words it, outside the body, and only at times, in certain conditions, invade it and become of a parasitic or disease-producing—pathogenic—character; as probably too do the germs of typhoid (or enteric) fever and of cholera, and, it may be, of diphtheria.

In 1891, Sir Hugh Beevor, it appears (at Patholog. Soc., London, Jan. 10th: Lancet), demonstrated that the tubercle bacillus can be cultivated at a temperature below 60° F., that of ordinary summer weather. In a book on the "Prevention of Consumption," published a few years ago, and later in communications to the Lancet, Mr. C. Chandler, of Melbourne, Aus., contends that the microbe in some form or phase grows "free in nature," in dark places: especially, he believes, in dark, foul bedrooms. This is an exceedingly important question. Further on, in considering the causes of consumption, it will be again discussed. At the present time we only know of a certainty that the source of the bacillus is from a case of consumption.

SAPROPHYTES AND PARASITES.

There are many species of small plants, such as most fungi (with which have been classed most of the disease germs), called saprophytes (from the Greek, *sapros,* rotten), the nature of which is to grow and flourish only or most naturally on dead organic

matter. This is the case, as we know, with some of the larger forms, such as mushrooms and some moulds. Now, it is possible, even probable, that all, the disease-producing bacteria, such as the bacillus of tubercle and of typhoid and other fevers, are naturally of this sort, saprophytic, and in their natural state live and flourish only or best in, or in association with, some form of dead matter, either within a living body or free in the outer atmosphere. It is improbable that a parasitic, disease-producing life is natural to these micro-organisms, but rather an accidental or acquired state. Indeed, it seems highly probable that they are rendered virulent and disease-producing by insanitary conditions. Evidence of their transformation from a saprophytic to a parasitic life accumulates with investigations. In respect to parasitic diseases of the skin and hair, for example, Leslie Roberts, M.D. (R. Infirm., Liverpool, Eng.: Brit. Med. Jr.), in a paper read at last year's meeting of the British Medical Association, gave the following valuable and suggestive information: "I cannot see how it is possible to avoid the conclusion that the hair-attacking fungi belong essentially to the saprophytes, and to that class of saprophytes which may, under certain conditions, adopt the parasitic life. The search for the *via naturæ* of these fungi, by which they ascend to their parasitic position on man, may be hopefully undertaken." Again, Doctor Roberts says, "We have seen that without any change in its saprophytic habitat the fungus may pass from an inert vegetable soil to animal tissue or hair." Respecting certain experi-

ments, he said, "They point, I think, with the force of a demonstration, to a source of ringworm and other vegetable parasitic diseases hitherto scarcely suspected, namely, dead organic matter."

A distinction is made between saprophytic and parasitic micro-organisms; the former living on dead organic matter, the latter on living bodies. The former are benign organisms—scavengers, so to speak; the latter feed upon the fluids or tissues of the body of their host, and may hence cause disease. When micro-organisms cause disease they are then called pathogenes (Greek, *pathos*, disease), or pathogenic organisms. The distinction between saprophytes and parasites is, however, difficult to clearly make out or define. These most minute forms of plant life may exist and propagate in living bodies without feeding upon the living fluids or tissues therein, but instead, obtaining their nourishment from any excess of the used-up, effete, dead products resulting from the various functions and processes of life, retained in the body instead of being thrown off by healthy acting excretory organs. Existing in this way, on such food, in a living body, such microbes are as strictly saprophytic as if living in or upon a dead body. Many of the organisms living in the human intestines, even the so-called parasitic worms, are doubtless more of the nature of saprophytes than parasites, as they do not thrive in a clean, healthy intestine.

In certain body conditions, which will be explained in future pages, saprophytic or benign organisms may become disease-producing or pathogenic.

To give a simple illustration,—a micrococcus naturally and commonly present in the saliva of healthy human beings, in certain conditions or certain persons, is so virulent as to cause the death of rabbits when the saliva is injected under their skin. The saliva is quite harmless when the cocci are taken from it. It has been suggested that a superabundance of the fluid may be the cause of the poisonous nature of the microbe in it, but this is probably, at most, a remote cause. The excess of saliva may give rise to some special condition which renders the micrococcus poisonous.

It is still a question with some high authorities whether the tubercle bacillus ever grows and propagates in healthy living body tissues, or, which seems much the more probable, only in altered or diseased, practically partly dead tissue—tissue containing elements of dead matter.

TUBERCLE IN OTHER TISSUES AND ANIMALS.

Other tissues besides the lungs, as already stated, are often the seat of tubercular growths. The intestines, the liver, spleen, kidneys and other glandular organs, the brain membranes, the skin and the bones, are subject to the disease. The muscles (flesh) are but rarely invaded. As the tubercle increases, the affected tissues gradually "waste away" and are replaced by the disease product, which, too, eventually dies and disappears or dries into a hardened lime-like mass. At the same time there is usually a general wasting of all the tissues. We have therefore tuberculosis or

consumption of many parts of the body. Next in frequency to the lung affection is "consumption of the bowels," chiefly characterized by a tubercular destruction or wasting of the glands along the course of the intestines. This is more especially common in young children, and is believed to be frequently caused by the use as food of the milk of tuberculous cows.

Many of the lower animals are also subject to this disease. Bovines appear to be more so than any others. It is common in poultry, pigeons and other birds. Horses, pigs, sheep, cats and dogs are less disposed to it. Rabbits, monkeys, and all menagerie animals kept caged or housed are very liable to the disease; indeed, it is the principal cause of death amongst these animals. Crisp, it is said, has met with tuberculosis in over one hundred different species of animals, including reptiles. It is very rare, if not quite unknown, in animals in a wild state. This indicates a good deal bearing upon the cause and prevention of the disease.

SIMPLE EXAMPLES OF PARASITIC DISEASES.

As a simple illustration of parasitic diseases, it will be interesting and instructive to briefly notice here an affection formerly believed to be tuberculosis, now technically termed actinomycosis, more commonly known in cattle as "lumpy jaw." It is an infectious disease, common in bovine animals living on wet soils, as the fen districts of Scotland, and is not uncommon on this continent. It is caused by the growth and multiplication in the tissues of the animal

of a star-shaped fungus; hence the name. This exists in abscesses formed near the jaw during the course of the disease, and commonly in the form of minute granular masses, or little grains, the larger of which can be seen with the unaided eye. Colonies of the organism, even with slight magnification, present to the eye a radiate pattern, and with a higher power, the centre resembles the heart of a daisy. According to Jensen, it grows on grain husks or straw. Many cases of the disease in the human body have been recorded. Saltmann reported a case in a boy which was caused by swallowing an awn of barley. An abscess formed near the throat in which was discovered the ray fungus.

Another example is the thrush or "white mouth," of young infants, especially of those who are hand-fed, and in badly nourished adults. It is caused by a parasitic fungus, *oidium albicanus*, and occurs in two forms: hyphæ (a web) and threads of spores. On cut potato it develops into thick white colonies. Injected into the veins of rabbits it causes their death in one or two days, the inner organs being filled with the hyphæ. This fungus is "specifically identical with *saccharomyces mycoderma*, or 'flowers of wine,' a ferment developed on the surface of liquids which are acid and contain little sugar" (Trouessart).

FORMATION AND PROGRESS OF TUBERCLE.

The local changes and conditions in the body tissues of the consumptive, and the general progress and symptoms of the disease, vary with the constitution

and condition of the individual affected, chiefly, and in a measure with the virulency or poisonous character (which varies with certain circumstances) of the tubercle bacillus. Into the lungs the bacilli gain access by being drawn in with the air in breathing. When they lodge there, it is usually, first, in the minute bronchial tubules which open directly into the air chambers. Infection, it appears, usually commences there. If the tissue condition be favorable, the soil suitable, and the bacilli be not too greatly attenuated (weakened), they "take root," a colony of them forms eventually, and a minute tubercle results.

The manner of formation of tubercle is highly interesting. In order to understand it one must bear in mind that the bacilli are exceedingly minute. One of the large white blood-corpuscles,—soft, jelly-like cells, penetrates the wall of a lung capillary, usually, and, as it were, sucks the newly arrived invading bacillus into itself with the purpose of digesting or destroying it; a process to be noticed further on. The corpuscle then becomes larger, the bacillus in it multiplies, other cells are attracted to, and join it, and a tubercle is there formed. A newly formed primitive tubercle consists of numerous small round cells packed together with a large or "giant cell," sometimes two, at the centre while within the cells to some extent, and more abundantly between them, are the bacilli. From lack of nourishment, as no blood vessels form in it and no blood can enter, and it may be, too, from the effects of a poison produced by the bacilli, destructive changes soon commence in the

centre of the tubercle, and extend till the whole degenerates into, or becomes, a mass of yellowish, fatty granules resembling cheese, and is said to be cheesy, or caseous. In this dissolution of the tubercle the bacilli usually disappear, probably leaving, however, a crop of living spores.

The time required for the development of tubercle and its degeneration or decay is very variable. In the more chronic cases of the disease the little masses form slowly, and remain small and few in number for a long time, months and even years, degenerating slowly, too: while in acute cases they may reach the size of a pea in three or four weeks. When the subject of them presents a particularly favorable soil, or when the bacilli are, or become, very virulent, tubercles form rapidly and in large numbers throughout both lungs, sometimes giving rise to rapid exhaustion, much difficulty in breathing and early death.

ANTAGONISTIC BODY FORCES.

As intimated above, and as will be explained more at length in another section, certain cells or corpuscles in the blood resist and endeavor to destroy and cast out disease germs; indeed, this is their action with any foreign substance whatever which has gained an entrance into any part of the body, as we find to be the case after the minutest thistle point has penetrated the cuticle and gone far enough into the true skin to cause pain or irritation. Moreover, in individuals in good health there appears to be in the

blood serum a germicidal or antidotal substance which is detrimental to the life of such foreign bodies as disease germs in the tissues. However this may be, tubercle, and indeed the whole disease process, and its products, in consumption, appear to be the direct result of a warfare for supremacy between the invading bacilli on the one side, and the protective bodily forces on the other, and in which the latter have been unable, from some cause, to successfully compete with and destroy the bacilli. The contest goes on. Too often the invaders maintain their positions, while they continue to gain new ones, increasing the tubercular formations and extending their depredations; and so the disease progresses. The minute tubercles formed coalesce and give rise to clusters of them or larger masses of irregular shape; air chambers become blocked up and their walls thickened, until at length portions of the soft, spongy lung tissue are replaced by masses of tubercle.

THE CHANGES ARE INFLAMMATORY.

The local disease process is really all through of an inflammatory, conservative character; indeed, a series of circumscribed points of inflammation set up by the bacilli, varying in degree and extent like the tubercular deposits—chronic or more acute, limited or more extensive—depending on, or according to, the constitution and condition of the subject or body affected, and the virulence of the bacilli. When a prickle from a thistle is forced into the skin, a process of inflammation is set up at the point and around

it, by means of which the prickle is eventually forced out. A fester commonly forms in cases of this kind, and along with the pus or "matter" discharged from it the offending prickle is thrown out. In some good constitutions we find the foreign particle is removed more naturally, or kindly, or with less irritation or pain, and in a shorter period of time, than in other constitutions, in which the process is more painful and tedious. Somewhat so it is with the bacilli in the lung tissue. In a susceptible body—in a person strongly predisposed to consumption, with impure, defective blood and other fluids, and consequent weakened tissues and blood cells, the bacilli, when they chance to be breathed in sufficient numbers into the lungs, find there an attractive field—abundance of suitable food—and make easy conquests, while they take on a more virulent character. The army of weakened blood cells or other protective forces can offer but little resistance. The inflammation set up is consequently of a low scrofulous form, against which the invaders make easy advances. On the other hand, when the little plant-rods, however virulent, find a resting-place on the mucous membrane of the minute terminal bronchial tubes of a well-cared-for healthy body, with good pure blood, a germicidal intoxicant and an army of vigorous protective cells, if the invaders be not carried out at once and first by the cilia on the mucous surface of the tubes (page 23), they are soon attacked by the blood cells: a "rush of blood" with more cells, if called for, now flows to the spot, and the process we term inflammation,

of the simplest kind, is set up and the unwelcome intruders are probably in due time satisfactorily disposed of, perhaps without the complete formation of tubercle at all. Possibly they may be then thrown out of the lung along with mucus, more or less thickened, by a slight cough. Indeed, it seems possible that many persons may at one time or another during life, or perhaps from time to time, and often, breathe in these bacilli (which are almost ubiquitous, from being spread about by the coughing and indiscriminate spitting of consumptives) and dispose of them in this way, the whole process or act seeming to be but the result of a "little cold."

In some cases—in certain constitutions or conditions—after a mass of tubercle has been formed in a lung, and after the individual has been brought into a more healthy, vigorous condition, as by medical treatment or a change to healthier living, then by a more vigorous, local inflammatory process, a strong wall of fibrous tissue is built up completely surrounding the tubercle, cutting it off securely and permanently from the body tissues and rendering it entirely harmless. In this way other foreign bodies or growths, as a leaden bullet, for example, is sometimes disposed of by the natural powers of a healthy vigorous body.

One great difference between the effects of the tubercle bacillus and the prickle of a thistle or other dead particle in the tissues is that, in the former case, by reason of the cause of the inflammatory action having life and power of multiplication, there is, if

the living microbes be not at once cast out or destroyed, a constant succession of new irritated points or causes of inflammation that will eventually wear out, exhaust and destroy the life of, the invaded body. Again, the bacillus is usually of a much more poisonous, irritating nature than the thistle point.

DIFFUSION OF TUBERCLE IN THE LUNGS.

If, then, on the first lodgement of virulent bacilli in a lung they be not at once cast out by the cilia or soon destroyed or enwalled by the protective germicidal powers of the body invaded, they multiply and form new centres of colonization and inflammation. They first, we will say, lodge and colonize, or "take root," in the upper part or apex of a lung; tubercle is formed there, which eventually undergoes degeneration, softens, and particles of the softened, cheesy matter, perhaps sometimes still containing living bacilli, or, if not, their spores—it may be both—are conveyed by the cilia on the mucous surfaces toward the larger bronchial tubes to be coughed up; in their passage, the cilia not being vigorous in action, perhaps broken down and destroyed in places, the germs find lodgement in other and new points, where more tubercle is formed, which likewise softens and spreads in like manner. Unless this development of new tubercle be stopped, gradually more and more lung tissue becomes involved in the inflammatory process and its worst consequences, and the function of perhaps the entire lung is destroyed. Particles of tubercular matter probably sooner or later find their

way into the other lung, and eventually large portions of both lungs become involved.

FURTHER DISEASED CONDITIONS.

During the progress of the disease it is very common for the inflammatory action to extend from the lungs to the pleura, especially to the visceral layer closely investing the lungs, and for the two opposed, touching surfaces of this smooth, lubricated membrane (page 25) to become much thickened and grown or "glued" together by the diseased action set up. A portion of the lung is then bound down to the wall of the chest and its action much limited. It is, too, the inflammation of the pleura—pleurisy—which in nearly all cases of consumption causes the pain, more or less of which is commonly experienced in the chest during the course of the disease.

Again, the larger tubercular masses formed in the lungs, perhaps after protective bodily efforts had constructed a fibrous wall partly around them—in such cases almost a fruitless effort—degenerate and discharge their contents, as the smaller tubercles do, as above stated, and the partial wall remaining, what is called a "cavity" is formed in the lungs: it is a place where a tubercle had developed, destroyed the lung tissue, and then itself degenerated and wasted away. In advanced stages of the disease it is common to find cavities in the lungs formed in this way, varying in size from that of a walnut to that of an orange, more or less irregular in shape, containing only air. In favorable cases, a cavity may become quiescent

and very gradually contract and close its walls together, or this may take place in a short time. In either case, eventually, only a cicatrix, or scar, is left. In less favorable cases the cavity may continue for a long time, perhaps many years, to secrete and give off from its walls a creamy pus—"matter."

And again, from defective inflammatory action, ulcers form in the walls of the bronchial tubes, which remain open, and pus is discharged therefrom. Suppuration in this way is common.

And yet again, gangrene—mortification—of a portion of the lung may take place, the blood supply having been cut off in some way.

In a few constitutions in which the progress of the disease is very slow, from the formation of an excess of fibrous tissue substance, as if intended, but not used, for encapsuling—constructing a protective wall around—a tubercle or tubercles, air chambers are, as it were, glued together, and the entire lung becomes less spongy and more dense: finally a large portion of it may become contracted, and solid—fibroid phthisis (some authorities, as already stated, believing this may occur without tubercle or the tubercle bacillus). Occasionally an entire lung becomes solidified in this way and quite inactive and useless for respiratory purposes. It is then commonly said that the lung is "gone." Entire collapse of clusters of air chambers—lobules—of the lung may result from the blocking up of bronchial tubules.

All these conditions are sometimes found in the

lungs of a person who had died of consumption, all brought about by fruitless protective efforts on the part of the invaded body to check the progress of the invaders. We can imagine the contest going on between the two forces in the lungs of an unfortunate sufferer from this dread disease—between the countless myriads of infinitesimal and now virulent microbes on the one side, and the blood cells and other protective or antidotal forces on the other. Too often, alas, the countless myriads conquer. The local disease becomes more and more extensive, and the entire constitutional forces more and more undermined and exhausted, until finally one more death from consumption terminates the struggle.

THE BRIGHTER SIDE.

We may here look mentally for a moment at the brighter side—at a case terminating in recovery. If at almost any stage of the local disease, while the general constitutional forces of the affected individual are not yet too far undermined, there may be reasonable hope of a practical, permanent cure by the application of proper remedies. If enough sound lung tissue be left on which to build up the natural body forces, by pure air and other remedies suited to the individual case, the depredations of the microbes in the lungs may be arrested and fair health again established. Sometimes, too, medication may be so applied as to directly lessen the virulency or vigor of the microbes, and their destructive work is then the

more easily checked as the natural powers of the body are gradually built up. In this way improvement may be brought about, slowly it may be, but surely. All diseased action may be eventually stopped, and the individual live on for many years:—with, it may be, a portion, or portions, of one lung bound down for life to the chest wall by pleural adhesion; or a dried-up cavity in the lung; or with the scar of a healed one; with, perhaps, an enwalled mass of dead, dried-up, calcarious, and so harmless, tubercular matter; or some collapsed air chambers; but withal, no diseased action, no living bacilli or their spores to cause further destruction—except it might be through reinfection from without.

CHAPTER IV.

CAUSES OF TUBERCULAR PULMONARY CONSUMPTION. IMPERFECT RESPIRATION AS A CAUSE.

GENERAL REMARKS: HALF REMEDIES.

Having sufficiently explained the nature of consumption, the causes of it may be now considered. Why does this fungus, the tubercle bacillus, grow and multiply in the lungs and other tissues of certain living human bodies and give rise therein to tubercle, the special characteristic of this disease, and not in other bodies? In short, what is the cause, or what are the causes, of consumption?

It seems evident, as we have seen in considering the nature of consumption, that the tubercle bacillus is one cause, indeed an essential cause, of the tubercular growths, and hence it must be regarded too as one of the causes of the disease. Practically, there is no consumption without tubercle and the tubercle bacillus.

Unfortunately, since the discovery of this microbe by Koch, many authorities and writers appear to regard it as *the* cause—too often, practically, the only cause, instead of *a* cause, of consumption. The consequence is that frequently only half measures are employed for either the prevention of the disease or

for treating it with a view to cure: because the measures are applied only, or almost only, to the destruction of the bacillus, and the other essential cause, or collection of causes, which favors its growth in the tissues, does not receive sufficient attention.

It is clearly evident that there is another essential cause of consumption, one at least, besides, and quite as indispensable as, the bacillus; as this organism will not give rise to tubercle indiscriminately at any time in anybody's lungs into which it chances to be conveyed. True, it is probable that no one is absolutely exempt from its effects: that is, exempt at all times and in any bodily conditions which may arise. Practically, however, three-fourths of the human race do escape altogether the poisonous effects of this ubiquitous parasite, although doubtless repeatedly drawing it into their lungs in breathing. This is not by chance only. There must be some special cause for it. What then is it? What are the conditions or causes which favor or permit, excite or enable, the bacillus tuberculosis to grow, or set up the tubercular process, in the living bodily structures of so large a number of persons? Again, what are the causes of consumption?

TWO ESSENTIAL AGENTS: AUTHORITIES ON.

It is plain, then, that in the causation of this disease there are at least two distinct, immediate factors or agents, each apparently as important or essential as the other: (1) the virulent tubercle bacillus—infection, germ or seed, and (2) the suitable, receptive, non-resisting or exciting body soil, commonly termed pre-

disposition—that specially fitted condition of the body tissues in which only the seed will develop and cause tubercle; and to the preparation or formation of which a number of mediate or more remote causes contribute. This is now the almost universal medical belief: that tubercular consumption cannot develop without the tubercle bacillus, nor can the bacillus give rise to the characteristic tubercle except in specially conditioned body tissues.

Professor Von Ziemssen, one of the most eminent medical teachers and authors in Europe, says (Pulmon. Tuberc.: translated by D. J. Doherty, A.M., M.D.: Detroit, Geo. S. Davis), "Experience compels us to acknowledge that the healthy organism has great power of resistance to the bacillus, which can make an effective and permanent settlement in the lungs, intestines, etc., only when certain favorable conditions are present. These conditions, this as yet unknown pathological something, we call a *predisposition*, and mean thereby a certain constitution of the tissues which furnishes a suitable soil for the settlement of the bacilli. We cannot at present get along without the supposition of such a predisposition, which may be either inherited or acquired. A disposition exists, in fact, for other infectious diseases, as typhus, cholera, dysentery, etc., and why should not one be supposed for the settlement of the tubercle bacilli? In what consists this predisposition which, next to heredity, plays the greatest role in the etiology of tuberculosis? We do not know."

Doctor Thorne Thorne (Med. Off., Local Gov. Bd.,

Gt. Brit.: in St. Barthol. Hosp. Rep., Vol. XXVI) writes, "My object is to indicate that, though the bacillus is one requisite of tuberculosis, the soil—whether human or other—in which it can flourish is another necessary one; and to urge that, whilst we are taken up with the fascinating researches of the bacteriologist, we may not forget how very usefully we, as practitioners of medicine, may occupy ourselves in restraining the disease by securing the adoption of measures tending to deprive the bacillus of the pabulum it needs for its life-processes and for the production of the mischief involved therein."

The late Sir Andrew Clark, Bart., M.D., etc. (Lecture on Clin. Cases of Tuberc. at Lond. Hosp.: Lancet, July, '92), after reference to Koch's discovery, said, "Now this brilliant discovery and the theory based thereon make it plain that there are two factors in the evolution of tuberculosis—the tubercle bacilli and the soil on which they grow; for it is certain that these bacilli will not flourish on every soil."

The late Professor Austin Flint, of New York, writes (Pepper's System of Med., Vol. III), "If we accept the conclusion that the bacillus [of tubercle] is the causative agent, it requires certain local conditions. Without these, the parasite is innocuous. The conditions are to its development and multiplication what the peculiarities of soil are to the production of different vegetables. We do not know the nature of these conditions. When they exist the bacillus develops and multiplies; when they are wanting, the parasite is incapable of development and multiplica-

tion. This dependence of the specific morbific agent upon particular conditions is exemplified in other infectious diseases. The contagion of the eruptive fevers, received into the system ever so abundantly, is inoperative in some persons. The contagion has not lost its vitality: the conditions for its activity are wanting."

Professor Osler (Johns Hopkins Univ., Balt., Md.) records his view in the following apt words (Osler's System of Med.): "There are tissue soils in which the bacilli are, in all probability, killed at once—the seed has fallen by the wayside. There are others in which a lodgement is gained and more or less damage done, but finally the day is with the conservative, protecting forces—the seed has fallen on stony ground. Third, there are tissue soils in which the bacilli grow luxuriantly; caseation and softening, not limitation and sclerosis, prevail, and the day is with the invaders—the seed has fallen upon good ground."

Doctor Andrew H. Smith, of New York (at N.Y. Acad. of Med.), says, "There are two factors to be taken into consideration, one being the seed, the other the soil, and in proportion as we make these facts clear to the public, will our advice for preventing the spread of tuberculosis be followed." When asked why so many escape when the tubercle bacillus is so plentiful, he answered by this illustration: "Rice sown on the top of a sandy hill will never bring forth a crop; or, prepare a river bottom ever so well, and sow no rice, there still will be no crop. It requires the proper seed, and also the proper soil to reap a harvest.

Applying this to tuberculosis: to prevent dissemination of the seed is very important, yet of equal importance is it to obviate preparing a suitable soil."

Doctor Stephen Smith Burt (Prof. Clin. Med., New York Post-Grad. Med. School, at N.Y. Acad. of Med.) declares that, "As without this parasitic plant, however depraved the constitution, there will be no tuberculosis, also, fortunately, with this morbific agent there will be no phthisis unless the vitality of the tissues is first impaired.

And Doctor E. H. Shurly, Detroit, says (Address, ann. meet. Am. Med. Assoc., '91), in respect to bacilli, "Their destiny depends upon a favorable *nidus* (nest) or *pabulum*." They "develop only where a *previous abnormal state* of the body suitable to them exists."

It may be stated here, then, at once, that in our efforts to prevent consumption it is not enough that we use means only, or chiefly, for preventing the spread of the seed and its probable spores. The incalculable numbers of these germs cast off by consumptives and existing everywhere render success in such one-handed efforts practically impossible. If, however, we at the same time make greater efforts to prevent the formation of the suitable stimulating soil for developing the disease germs, we shall have at least double the chances of success from our preventive efforts: while, as we shall see more clearly further on, we shall also at the same time promote the development and growth of cleaner, healthier and more vigorous human beings.

PREDISPOSITION: WHAT IS IT?

One essential factor in the causation of consumption, the tubercle bacillus, having been sufficiently discussed, let us now inquire carefully into the nature of that special condition of the human body, or body tissues and fluids, which constitutes the other essential factor—the soil, or predisposition—for exciting or fertilizing the bacillus, and of the causes which give rise to this condition. Let us, if we can, make plain why it is that many persons fall ready victims to the disease, while many more possess the immunity from it,—resist the destructive influences of the ubiquitous fungus. Let us, if we can, learn how all may retain or acquire immunity from consumption regardless or in spite of the bacillus.

A great deal has been said and written, much of it long, long ago, on the subject of "susceptibility" or "predisposition" to, and on "predisposing" causes of, consumption. Almost all sorts of morbid bodily conditions, and the causes of these, have been named and discussed as "predisposing" causes, or as giving rise to the predisposition: to which condition the term "favorable soil" or "suitable soil" has been more recently applied. Most of this has been unsatisfactory; much of it misleading. What the predisposition is, or the nature of it, has never been fairly defined, hardly even in a measure. In his work recently quoted, Von Ziemssen describes the outward and visible signs of the inward body condition. First, in reply to his own question—"In what consists this predisposition?" Von Ziemssen says, "We do not

know." He then continues: "We know in a general way how a man looks when he has such an inherited disposition," and the causes which may engender it; "but we do not as yet know its nature or the morphological, chemical or physiological changes to which it owes its origin." "Of the slender body, the flat chest, the thin limbs, the delicate tinge, the vulnerability of the vessels of the mucous membrane, the tendency to nose-bleeding and to catarrhal inflammation of the larynx, the frequency of cardiac palpitations and congestions, the circumscribed redness of the cheeks, etc.," there is often "but little to be made." He adds: "How many robust young people are tuberculous in spite of their compact bodies, stout muscles and natural color! Here there is still much to be investigated." Equally unsatisfactory are all explanations respecting the cause or causes of this predisposing condition of body which constitutes the tuberculous soil.

Heredity has been long the great bugbear in connection with the causation of consumption: but it is now well known that, as usually understood, it is not comparatively a very important factor, or is not so important as it was until recently supposed to be, as we shall see further on. Life insurance companies are less shy of it in applicants than they once were. Various sorts of depressing influences, such as insufficent and improper food, exhausting discharges, overwork (mental or physical), night vigils in care of the sick, unhealthy dwellings, alcoholism, atmospheric dampness and "colds," the effects of fevers and other

diseases, especially those more particularly affecting the air passages and lungs, as measles and bronchitis, have all been put down as favoring more or less the formation of the so-called tuberculous soil.

Breathing foul, prebreathed air in rooms, shops, schools, etc., from want of ventilation, has been long regarded by high authorities as a particularly strong predisposing cause of consumption. Probably this is more deserving of the charge, and to special consideration, than any other commonly named cause.

In most cases of consumption, many causes and influences have been in operation. Anything which lowers the health standard gives rise to a certain amount or degree of predisposition to all infectious diseases, and indeed probably to all diseases whatsoever, but not in a greater degree to consumption than any of the others.

Again, persons who are naturally not of vigorous general make-up or constitution, or who are "weakly," or perhaps not in good general health, providing the lungs are proportionately developed and exercised, are not particularly liable to consumption. Even anæmic —"bloodless"— persons have so rarely become subjects of the disease as to have been erroneously regarded by some authorities as exempt from it.

It seems impossible to understand how so many various kinds of causes can give rise to that special condition of the living body tissues which fits them for the growth and propagation therein of this fungoid plant, the bacillus of tubercle, which, too, seems to demand for its growth a soil so peculiar as it

evidently does; and this the more so, because all persons upon whom these various causes operate, even in full force, or in whom the various conditions named exist, do not become tuberculous or consumptive.

A "scrofulous diathesis" or condition, or a "strumous habit" or condition, are terms commonly applied to certain persons, mostly young (they often do not survive adolescence), who are found to be more particularly disposed to various forms of tuberculosis. Such persons are marked by the characteristics quoted from Von Ziemssen, and are subject to glandular enlargements in the neck, to tubercular diseases of joints and bony structures—"white swellings"—and probably, in well-marked cases, have a thickened upper-lip, and a partly-open mouth, habitually, from swollen, obstructed nostrils. But whence or what is the cause of this condition—the "scrofulous habit?" It is often hereditary; yet often acquired, especially in cities. High authorities have declared that it may be caused by breathing a foul, especially a prebreathed atmosphere.

This brings us now nearer to what in my opinion will be found to be most intimately and directly associated with the special cause of the production of the tuberculous soil or predisposition—intimately and directly associated with the second essential factor in causing consumption: namely, a proportionately small breathing capacity—small or defective lung membrane surface—insufficient respiratory action or function. Consequent on this there is, first of all, a want of sufficient oxygen in the body for that

perfect tissue change or metabolism which is essential to health and life; practically, insufficient for the complete oxidation of the waste products of life and purification of the blood: and, second, accumulations in the air chambers, fluids and tissues, of such dead matter as on decomposition affords inorganic food for the saprophytic bacteria, as well as, probably, intoxicating organic substances to be noticed on future pages,—dead matters which, with a perfect respiratory function, would be thrown off.

Some of the above-named predisposing causes, and others now long recognized as such, first of all predispose to a want of full respiratory action—to shallow breathing, or a morbid, perhaps thickened, condition of the lung membrane forming the air chambers. Hence these are indirect or remote predisposing causes. And anything which habitually or for a length of time restricts the breathing or obstructs the breathing function—the free exchange of gases—such as breathing foul air, is a remote predisposing cause. It has been said, for example, that "most potent predisposing causes of tubercle in infants are rickets and measles" (W. S. Coleman, M.D., M.R.C.P., etc., at ann. meet. Brit. Med. Assoc., '93). Why? Because these affections tend strongly to limit the respiratory function: rickets, probably chiefly by its contracting influence on the chest and lungs; measles, by producing a morbid condition of the air chamber walls.

Now, is it not possible that this second causative factor may be more clearly defined, in order that we may bring our preventive forces more directly

against it? We have learned clearly enough that it is an absolutely essential causative agent. It seems highly probable, taking in all the circumstances, that it is something more definite, special, peculiar, than it has been generally supposed to be,—something actual, more than a negation, more than a *want*, as of vigor or "tone," more than defective nutrition or lowered vitality,—that it is a positive substance, antecedent to these conditions. Is it not probable that it is a poisonous substance, perhaps of the character of a ptomaine, produced in the body from the decomposition of the retained debris of imperfect tissue change or wear and combustion, consequent on imperfect respiration? and that this, while depressing the vitality of the entire body, including the protective phagocyte cells, also, and particularly, acts as a germ excitant or intoxicant, probably along with a germ nutrient from the same source, and so gives rise to the virulent action of the bacillus and the eventual production of tubercle? The lowered general physical vitality which is now looked upon as the effect of the tubercular state, is probably a pre-tubercular condition, the result of the action of this substance and not of the bacillus.

It is my purpose to show now that some such substance is probably produced in the body, and is more truly the immediate exciting cause of consumption than is the tubercle bacillus. We may not be able at the present time to make it clear—to put our finger upon it, as in the case of the seed—but we may learn enough to enable us to work more successfully toward removing this second, personal or body factor, or preventing its formation, than we are now working.

VEGETATION AND SOILS.

Before I proceed further to endeavor to bring out evidence in support of the theory that a toxine formed in the body excites the tubercle bacillus into pathogenic action, it will be well to touch very briefly upon the nature of vegetation in general in its relation to soils: and more particularly upon the relation to so-called tissue or body soils,—as well as to various conditions of circumstance and environment, of these lowest known forms of plant life to which the tubercle bacillus and other disease germs belong.

We know that while some of the more highly organized plants will grow and flourish in some localities and soils, they will not in others, as well illustrated in the quotation given a few pages back from Doctor Andrew Smith, respecting the growth of rice. Some seeds will not grow in low damp ground: others will not in high and dry places. In some soils there is a want of some certain element which certain plants need, while in others there are elements antagonistic to the good growth of certain plants. Temperature, of course, has much to do with plant life, the plants of the tropics not flourishing in northern climates. Somewhat so it is, doubtless, with the human body and the parasitic, disease-producing vegetal organisms called germs or infections. Some children long escape scarlet fever although often exposed to its infection, and probably taking it into their body; yet they may take it later in life when in another different, or a special, body condition, or it may be when exposed to a more virulent infection.

Some individuals will not take small-pox even when much exposed to the disease: their body does not provide the special condition in which only the infection can develop. The vaccine virus will not "take" in some persons. As Doctor Flint words it, "the contagion has not lost its vitality; the conditions for its activity are wanting." Comparatively few of the population—one-eighth to one-fourth—take consumption. Why?

RETAINED BODY EXCRETA: CARPENTER'S THEORY.

It is well known that when the excretory organs of the body—the skin, kidneys, lungs—are not in a healthy, active condition, it may be, from overwork of the organs, then the waste products of life--of the wear and tear of the tissues, of the combustion by which the body is kept warm, and of products of excess of food consumed—are not thrown out by these organs, as in health, but instead, accumulate in the blood and other fluids and tissues of the body, constituting impurities—dead, decomposing matter, "food for bacteria." Doctor Burt says, "Waste products circulating through the organism, not properly oxygenated, form an attractive field" for bacteria. "The food of the tubercle bacillus is the debased blood and tissue which have been inherited or acquired."

Eighteen years ago, in an address at the annual meeting of the British Medical Association, Doctor Alfred Carpenter announced it as his belief that the retention of used-up waste matter in the blood, from want of proper activity of the various excretory

organs of the body, is one of the essential causes in the development of infectious diseases. Doctor Carpenter then advanced a theory which is in such exact accord with my own experience and observation since that time that I quote his words, at considerable length, as follows (Can. Health Jour., Vol. II, Sept., '76): "I much doubt if these living organisms [disease germs] could have any effect upon the body if the recipient of them were perfectly healthy; if no impurity existed in the fluids of the body; if the blood contained nothing foreign to a healthy and natural state. If this be so, a question arises as from whence these impurities proceed, and how their effects are to be guarded against. I venture to put forth an hypothesis for consideration, which will explain much that is difficult to understand on any other view. Some impurities must exist; they are the used-up matters, the result of the act of life, or they may be inherited tendencies, which have resulted from former neglect of sanitary law, and which have depreciated the quality of the stock and rendered it more susceptible to bad influences. The impurities naturally increase if there are any defects in the sanitary arrangement of the individual *corpus*. Their presence is of no moment if they are not in excess, and if they are removed from the body as fast as they are formed, or in the course which they naturally follow. Let me represent them by x in an equation in which the factors x, y, z (as a total) represent any form of infectious disease. The problem is to assess the value of each factor in the equa-

tion. . . . Let x equal u and e: u being the used-up material, always in the act of formation, is not foreign matter, and is not in ordinary proportions injurious to life. It is always being diminished as fast as it is formed by one or the other of the excretory organs which exist for the purpose of removing it. If all the excretory organs and all the functions are healthy, and all doing their work properly, the body is in good health, there is no excess of used-up material, no debris of combustion. If, however, one or other of the excretory organs fails to do its duty from either overwork or inertness, something is left in the humoral system, and e [the second subfactor forming x] is added. It becomes a positive quantity, and represents the excess of matter which should have been removed; u and e equalling x. They have a common origin, being the debris of the act of living; e will differ in quantity as well as quality. It will be modified by personal character, by actions, by non-actions, and even by attainments, but especially by attention to, or neglect of, sanitary and moral laws . . . If e be absent, x is not complete, and x, y, z [the infectious disease, or epidemic], cannot arise. . . . The germ or living organism, z, the particular contagium, the multiplying focus of infection, has to be introduced from without, and is capable of modification according to the character of the soil into which it may happen to be transplanted. . . . Just as *pencillum glaucum* requires the sugar and the temperature to produce alcohol, so z, the contagium particle [in order to cause disease], requires the food upon which

it increases and multiplies. . . . The severity of the disease will depend, not upon the character of z, but upon the quantity of e, which exists in the factor x : z will be reproduced according to the quantity of food, in the recipient body, upon which it can increase and multiply. If e be absent, the effect of z will be nothing; there is nothing for it to feed upon. If, therefore, personal cleanliness be attended to, if all the excretory organs of the body are properly exercised, . . . the effect of z, whenever it happens to be introduced into the body, will be reduced to a minimum, and may be so dwarfed as to be unable to effect a lodgement; it may die out entirely. It will be by directing attention to the necessity of diminishing the growth of e that we shall prevent infectious diseases from spreading, rather than by useless attempts to keep out z." Certain meteorological states, Doctor Carpenter represents by the factor y, as above given. These may, it appears, in a measure influence the body condition, or the infection z, making it less, or more, virulent, as by atmospheric dryness or moisture, etc. Doctor Carpenter says, "A municipal anthority, who allows overcrowding, foul air, immoral acts on the part of the people, impure water or bad food, is providing an excess of e, and increasing the danger which may arise from the introduction of z."

WHO TAKE INFECTIOUS DISEASES?

Now, who are the people who, as we find in practice, most commonly "take" infectious diseases? Not the clean-skinned and clean-blooded.

It may be most reasonably and fairly concluded that the Creator never intended man — that man never was designed—that it is entirely contrary to nature for him—to become the easy prey of any of these low forms of parasitic life so long as he lives in a proper manner—in reasonable accordance with the requirements of nature or of health : barring, perhaps, cases in which ancestors had greatly "sinned." Charles Denison, A.M., M.D. (Prof. Chest. Dis. and Climatol., Univ. of Denver, Col. : Essay, "Exercise for Pulmonary Invalids") says, "It must be, indeed, a peculiar accident which will result in nature's harboring tuberculosis in a physically perfect human being. But accidents will come, and perfection to meet them is very seldom or never to be found. For this reason are we doctors."

It is well known that besides the great majority of mankind who are hardly in any way clean, there are many persons, many most estimable persons, who, while absolutely clean of skin—clean on the outer surface—from frequent and regular bathing are not clean within ; whose blood and other body fluids, and even tissues, contain an excess, small or greater, of used-up, waste, dead matters, the refuse of the functions of life—the dust of wear and the ash of combustion :—which in well-proportioned, well-functioned, and well-cared-for bodies are cast out gradually as they are produced by the excretory organs. Briefly, in a very large proportion of the people who make up the masses of humankind, on account of some organic defect or bad habit, either inherited or acquired, such

as that of a small chest or habitual shallow breathing, these waste matters are not in their full measure cast out, but accumulate in the body, constituting the e of Carpenter—"attractive food for bacteria."

OF THE POISONS GENERATED IN THE BODY.

There is a great deal yet to be learned concerning the chemical and physiological changes which take place in the blood and other fluids of the human body from an excess therein of the waste of the processes of life—concerning the leucomaines, ptomaines and the many other combinations formed thereby; and concerning the relations these bear to saprophytic and other micro-organisms in the body, and also to certain bodily derangements. It may yet be found that such combinations constitute special attractive sustenance for special micro-organisms, which are, or which may only then become, the germs of disease,—combinations perhaps poisonous to the body, which the so-called disease germs are benignly designed to appropriate—to consume, break up or destroy, for the preservation of the body. Toxic substances are probably thus formed which transform benign micro-organisms into pathogenic or disease-producing germs.

Only a few years ago the late Sir Andrew Clark made it clear that anæmia and chlorosis ("green sickness") are caused by poisons arising from retained accumulations of fecal matter in the intestines—by fecal poisoning or intoxication—a condition which Bouchard designated as stercoræmia: as in cases of habitual constipation in young women. There is

evidence, and appears to be no doubt, that toxines from the same source frequently give rise to so-called "malarial" affections, neuralgias, "biliousness," and various forms of headache. From observations and experiments by Doctor Hattie, of Halifax, Nov., it appears that epileptic seizures sometimes have a like origin. Doctor Hattie's conclusions are supported by Doctor V. Romaro (La Sema. Med.: New York Med. Jour., Nov. 24, '94): who, furthermore, has found inhalations of oxygen "very beneficial" in the treatment of such "convulsive neuroses." "The oxygen," he says, "counteracts the asphyxial state of the tissues and destroys the ptomaines, the accumulation of which in the organism is often responsible for the convulsive paroxysms." It is not yet known whether these poisonous ptomaines act on the body directly, or whether they act through the influence or medium of certain micro-organisms. It is not improbable that the poisons first affect certain microbes.

It is unlikely that the typhoid fever bacillus will give rise to its poisonous effects except in a foul intestine; nor will the cholera vibrio. Nor is it at all likely that the tubercle bacillus will give rise to tubercle in a clean, fully used and well-ventilated lung. The foul, stagnant air—air loaded with accumulated effete matter—in the remote recesses of the air chambers of the lungs, from want of full respiratory action, constitutes a favorable condition for its saprophytic life, and where, too, it may be readily influenced and changed—made virulent, or more virulent, by abnormal toxines.

ARE DISEASE GERMS ORIGINALLY BENIGN?

The germs of typhoid fever and consumption are ubiquitous. Yet with a large majority of persons, into whose body they are doubtless often received, they are practically harmless. May we not ask, are they not sometimes, as in their natural, saprophytic condition, actually even benign organisms—scavengers, working in accordance with natural, universal law? becoming virulent and pathogenic in consequence of man's own unhygienic habits—intoxicated into virulence by poisons generated in the human organism?

One well-known bacillus, which is, it appears, constantly present in the healthy human intestine, the bacillus coli communis (common bacillus of the colon—lower bowel), is in its natural state evidently a benign organism. Yet the results of investigations make it highly probable, and to the minds of some of the highest authorities, absolutely certain, that it is sometimes in some way, especially in collections of excrement, as in privy pits, and possibly in a foul intestine, transformed into the virulent bacillus of typhoid fever: thus satisfactorily explaining the occasional so-called *de novo* origin (arising anew, not directly from another person) of this disease. For that it does sometimes arise in some such way, *de novo*, has been long maintained by high authorities; as apparently also do other infectious diseases, as diphtheria and typhus.

True, Doctor Klein, F.R.S., etc. (address at Sanitary Inst., Sept., '94) tends to throw doubt on this. Yet the slight though persistent differences Doctor

Klein finds between what he believes to be two distinct organisms (the bac. coli and bac. typhosus) may on further investigation be reconciled to the view that they are originally one and the same. The polymorphism (change of form) of these low vegetations is as well known as it is remarkable. We may note the different forms taken by one of the minutest of them, the micrococcus:—thread-like, spiral, and dumb-bell forms. From the investigations of Metschnikoff, Weiber, Wiltschur and others, it appears evident that the cholera vibrio, the coma bacillus, of Koch, takes other forms, and under the influence of various external conditions changes both its morphological and biological characters so that "it may even become indistinguishable." And it is asserted that these changes do not warrant the belief that there is more than the one variety of cholera germ.

Dickson, of Philadelphia, and other investigators have obtained thread-like, branched and club-shaped forms of the tubercle bacillus. In the ostrich, Crookshank informs us, this bacillus is very long, and sometimes presents a "terminal enlargement" (Com. to Path. Soc.). Klein himself not long ago, it appears, stated that the bacilli of diphtheria, of anthrax, and even of tubercle, are variable and not such well-marked typical bacilli as they have been supposed to be. Furthermore, since writing the above, I find in the British Medical Journal (March 9, '95), after some comments on "a detailed account of the morphology" (form and structure) of the tubercle bacillus by Coppen Jones, the following, by

the editor of that journal: "The polymorphism of some of the higher fungi is referred to and a number of observations are mentioned, which tend to show that bacteria formerly looked upon as monomorphic [of one form] are only stages in the development of more complex forms." Bunge, contrary to Klein's experience, has found the larger number of flagella or cilia (seemingly the motor organs), on the colon bacillus. Doctor Veranus A. Moore (Bureau of Anim. Indust., Wash., D.C.) says, the flagella of such closely related bacilli as these two and that of hog cholera "resemble each other so closely that they cannot be considered as specific characters." It is, then, easy to believe that the typhoid bacillus, notwithstanding its different effects on milk, etc., as observed by Klein, may be a transformed colon bacillus. Cilia may but be pushed out to enable the organisms to reach the surface of their containing fluid in order to obtain oxygen; possibly a temporary change.

However this may be, it is evident that the common benign bacillus coli is not infrequently transformed, if not into the true bacillus typhosus, into an equally virulent disease-producing germ. The editor of Modern Medicine and Bacteriological Review (Aug., '94), after referring to investigations by Doctor McWeeney (Prof. Path. and Bac. Royal Univ. of Ireland), in a case of fever indistinguishable from typhoid, but which disclosed no other infection than the bacillus coli, and also in an epidemic of typhoid fever at Waterford, England, remarks: "The evidence afforded by these observations is, that a

bacillus possessing the characters of both Eberth's bacillus [of typhoid] and the bacillus coli is capable of producing typhoid fever, and that a disease indistinguishable from typhoid fever may be produced by a microbe which is unquestionably the bacillus coli." Doctor Gabriel Valet, indeed, has shown that by cultivation of the bacillus coli in fecal solutions, it may become more virulent, more poisonous, than the typhoid bacillus.

Now, what so changes the character of this usually benign, probably very useful micro-organism, the bacillus coli? Doubtless some toxic substance formed in the decomposition of the fecal matter. Is it not probable that such substance may be formed in the decomposition of accumulations of fecal matter in the neglected intestine of a living human body, and there and then produce a like effect upon this bacillus?

It need hardly be stated that this part of the subject has been thus dwelt upon with the view of showing that it is possible the tubercle bacillus may be influenced and transformed in like manner from a benign saprophyte into a parasite or pathogene by the foul air in the air chambers of the lungs, or by poisons generated therefrom.

It may be here observed that in accepting the theory of polymorphism as correct, to the utmost limit, it is not denied that like produces like, persistently, in like influences of circumstance and environment.

EFFECTS OF ENVIRONMENT ON DISEASE GERMS.

With the view of showing further how certain body conditions may affect the tubercle bacillus when it chances to get into the body of certain persons, and of drawing more special attention to the body causative factor, the "personal equation," let us briefly notice the direct effects, upon some of these low forms of life, of the conditions in which they are placed or which surround them,—of oxygen and sunlight, of cultivation, of soil and temperature, and of the diet and habits of the host in which the organisms live.

That associated circumstances and conditions—air, soil, food, etc.—have marked influences and effects on the life and characteristics of all living organisms, animal and vegetable, is well known, and need not be further noticed. Man himself is largely a "creature of environment."

Crookshank says the importance of environment on micro-organisms is shown by the morphological differences observed in artificial cultivation under varying conditions; and, he adds, by the fact that by successive cultivation the tubercle bacillus can be "educated to grow upon a medium which is unsuitable for obtaining primary cultures." And it is well known that by various forms of cultivation, especially through the bodies of certain lower animals, the virulency of many disease germs has been so reduced as to give rise to the practice of inoculation of the thus attenuated germs or their milder products as a preventive measure. Trouessart states that the same

result may be obtained by adding various antiseptic substances to culture liquids, and thus weakening the virulency of the microbes. Doctor Arthur Ransome, F.R.S., has reported a series of observations (Proceed. R. Soc.) to prove that fresh air, light, and a "sandy soil have a distinct influence in diminishing the virulence of the tubercle bacillus." The soil he appeared to regard as having a special influence. It has been long ago observed that consumption is more prevalent in communities living on impervious, moist soils than amongst those on open, dry soils: a subject which will be more fully treated in another connection. Trouessart says, "Certain facts observed in medical practice have led to the surmise that whooping-cough may be regarded as an attenuated form of croup, just as vaccinia is an attenuated form of small-pox." On the other hand, fowls are not naturally susceptible to splenic fever, or anthrax (a disease communicable to man), but Pasteur rendered them susceptible by immersing them in water for two or three days and so reducing their temperature, which is higher than that of mammals. Chauveau has shown that compressed oxygen will considerably modify the virulence of the bacillus of anthrax; confirming Pasteur's view that the oxygen of the air attenuates, and even extinguishes, the virulence of an infection. The rat, susceptible to the anthrax infection when subsisting on a vegetable diet, is not so when on an animal diet. The house-mouse may be inoculated with septicæmic ("blood-poisoning") infection from another house-mouse, but not from a field-mouse, and *vice versa*. It

has been the subject of observation that epidemic and other diseases, Asiatic cholera, for example, are more virulent a few days after the Sunday feasting in which the masses of the population commonly indulge. There appears to be now no doubt that the virus of vaccine matter, the specific infection of the mild cow-pox used in ordinary vaccinating, is originally the same as that which gives rise to small-pox in man. By culture—by passing through the body of the bovine animal, the virulency of the infection is modified. Apparently originally from bovines, it becomes in some way much more virulent in the body of man.

On the other hand, how is it, it may be asked, in the case of direct inoculation with human small-pox infection, from man to man, for producing a milder form of the disease?—a preventive measure introduced into western Europe from the East and much practised a century and a half ago. The individual to be inoculated is subjected to a course of preparatory hygienic treatment, in order apparently to cleanse the body from excess of effete matters or impurities and invigorate the system. Is it not possible that, if this preparatory treatment were properly carried out for a sufficient length of time, the body would be then so purified and invigorated throughout that a natural immunity would be thereby brought about as effectual as by the inoculation process?—that then the infection when inoculated into the body would not give rise to the disease at all or produce any noticeable effect? Is natural immunity and the usual exemption from a second

attack of an infectious disease anything more than the influence of a complete cleansing and purification of the body, together with a certain adaptation of tissues and functions to any future action of the same infection ?

DORMANT OR LATENT GERMS IN THE BODY.

A few words here on this subject will be instructive. In the case of all infectious diseases a period of time elapses between the time of taking the infection into the body and the manifestation of the symptoms, or the apparent commencement of the disease. This is termed the period of incubation, and varies in the different diseases ; and also, mark, in the different individuals. That there should be such a period is easily understood : it being the time required for the special infective germ to propagate itself—multiply—and spread its influence. But why does this period vary so much as it does sometimes in different individuals in the same disease ? This must be caused chiefly, if not entirely, by a difference in the condition of the body fluids and tissues—the body factor : the variation in the virulence and fatality of different epidemics of the same disease being doubtless due, in the main, to variations in the virulency or vigor—the more luxuriant growth—from the start, of the infecting germ ; atmospheric influences, too, sometimes having an effect.

Aside and quite different and distinct from this incubation period, disease germs sometimes lie in the human organism, apparently in a latent or dormant

state, doing no harm, for weeks or months and possibly a longer time. This is not easily accounted for. It can only be reasonably associated with the body condition, or explained by variations in that condition. Doctor R. S. Adams (Med. Rec.), in a series of recent throat examinations, found the bacillus of diphtheria—the Klebs-Leoffler bacillus—in the healthy throat, "doing apparently no harm." Tronessart, believing that the dual nature of the diphtheritic infection is not yet fully established by the researches of Klebs and Leoffler, but that the apparently two organisms are but different phases or forms of one, explains the origin of a case of the disease in this way: A child contracts a simple catarrhal angina or laryngitis (an inflamed condition of the larynx); the micrococci, which up to this time remained inert in the mouth, begin to grow and multiply under the influence of the inflammatory products which favor their development; the plant which has been dormant becomes widely diffused. There are many degrees, he adds, between croup with malignant complications and the mildest diphtheritic angina.

From recent investigations by Straus (N. Y. Med. Jour.), it seems that living tubercle may exist in the nostrils of healthy persons and not give rise to any ill effects, although they act virulently when afterward inoculated into certain guinea-pigs. During an epidemic of measles in Munich, Bollinger had repeated opportunity "to demonstrate on the bodies of children who had died of that disease, the presence of tubercle bacilli in the lymphatic glands, especially

of the root of the lung, although previous to the sickness the children had been apparently healthy and not at all scrofulous." Baumgarten believes children may be born with the tubercle bacillus or its spores in their body, and that the future history of the germs "depends on favorable or unfavorable conditions of the tissue soil of the host." Solles, taking a similar view respecting children inheriting the actual seeds, says that during the first years of life "there seems to exist a period of variable duration in which the spores of the bacillus, although capable of being *stirred into activity*, are yet capable of being thrown off," as by the excretory organs. (He did not use italics.) Ziemssen says, "Cases of unintentional 'tubercular inoculation' have occurred, where a slight injury (such as drawing a tooth, a small cut, etc.) has led to secondary swelling of the neighboring lymphatic glands, and in these glands, after extirpation, giant cells with tubercle bacilli have been found. Such cases, however, are of doubtful value, for the bacilli may have dated from some earlier period and may have merely become manifest by reason of the traumatic lymphadenitis [inflammation of the gland caused by the wound]. The value of experimental inoculation must remain doubtful so long as we have no guarantee that the lymphatic system was previously free from bacilli, and for such a guarantee we can scarcely hope. . . . That tuberculosis may exist and, perhaps, has existed for years in a child apparently in full health is often learned accidentally. A single swollen gland, carefully extirpated from an otherwise blooming and healthy

child, has been found to contain giant cells with bacilli. How long were these in the body? Are there other foci of infection in the glands? Who can answer?" There is much truth in the remark of Doctor Mays, that tubercle, in itself, consequently the bacillus of tubercle, is not so deadly as it seems to be when judged from a standpoint of acute pulmonary tuberculosis. "It would not possess such a great fatality were it not that it involves and overpowers organs the full integrity of which is absolutely essential to life." It is well known, too, that cows may be apparently in the best of health and condition, and continue to give abundance of milk, while in various tissues of the body are numerous tubercles. Brush says the bovine race can be tuberculous from birth to old age, and yet not die of this disease.

On the theory that saprophytic or benign micro-organisms may be transformed into pathogenic germs—that so-called disease germs in the body doing apparently no harm may be rendered virulently active by certain bodily conditions, the various anomalous cases, or series of cases, of illness occasionally reported, as well as the *de novo* origin of typhoid and other fevers, and of consumption, and also certain other peculiarities in connection with germs, may be fully and satisfactorily explained.

EFFECTS OF IMPERFECT BREATHING.

Without further discussion or inquiry as to whether or not it be probable or possible that the tubercle bacillus has ever been, or may still be in

certain circumstances of environment, of a benign or purely saprophytic character, we will now after these lengthy and somewhat digressional remarks on micro-organisms, return to the further consideration of the so-called predisposition, or soil factor.

Forty years ago, in my early student days, from a special case which deeply interested me, I received a strong impression that defective respiration—a want of full respiratory capacity or activity—constitutes a particularly important factor in the causation of consumption. The more thought, observation and study since then given by me to the subject, the more convinced I have become that such is the case. Indeed, previous to the remarkable developments and discoveries in biological medicine during the last decade or two, the belief was growing that the disease could be produced solely by want of full expansion and exercise of the lungs: and it is now my firm belief, that no one will ever have it so long as pure, cool air, with abundance of oxygen, passes freely into and out of, and fully inflates, every air chamber and keeps them free from the accumulation of the waste matters dumped into them from the blood. During a third of a century in practice, I have had many opportunities of observing and studying, on the one hand, the evil effects of want of full respiratory capacity, whether inherited or acquired—tuberculosis being the most common ultimate result; and on the other hand, the good effects, often prompt and marked in consumptive persons, following an improvement or increase in the respiratory function. I could, would space permit,

give the detailed history of many cases clearly confirmatory of this.

When we bear in mind, what may be here repeated, that all the blood in one's body, after it has been the round of the greater circulation—to every part of the body—given up to the tissues its charge of oxygen, and gathered from the tissues its load of used-up waste, is sent from the heart to the lungs; that there, spread out in the capillaries laid over the air chamber walls, about once every minute, it all moves slowly enough to give off its load of waste stuffs and get in exchange its red corpuscles reloaded with life-giving oxygen, before it flows back to the heart to be again sent to all parts of the body; and also that in natural respiration the air chambers are first fully expanded, and then they contract and force out the waste matters with the breath into the outer atmosphere :—when we remember this, then it is easy to understand the evil effects on the system of shallow breathing with small or cramped, contracted lungs—of want of full expansion, with free ventilation, of the air chambers. When the air in the air chambers is not renewed in a proper measure as it should be with every breath, but instead, becomes stagnant from want of being changed by full breathing, it soon becomes loaded with poisonous materials from the blood, gathered from all parts of the body. The blood can then no longer continue to fully unload itself into the chambers already overcharged with waste, and so the poisonous substances accumulate in the blood. Furthermore, the blood corpuscles cannot

now get their load of oxygen, for it is not to be had in sufficient quantity from the foul air in the air chambers. The entire organism then suffers in the various ways already explained.

It will be well to note here the remarkable fact that the human body will gradually adapt itself, in a measure, to various insanitary conditions. For example, one may in a little time, from use, breathe an atmosphere, as in a crowded room, which at first seemed quite unbearable. But as Kirk says (Phys., Vol. I), "Such an adaptation can only take place at the expense of a depression of all the vital functions." In the case of acquired defective respiration, the system often tolerates the injurious effects for a long time without manifesting any particular symptoms of injury,—the effects coming on, too, gradually, as the habit of shallow breathing gradually increases; such respiration is injurious from the first, all the same.

In persons in whom the lungs are relatively small from heredity, although fairly exercised to their full capacity, the ultimate effects on the organism are much the same as in persons with imperfect action of relatively larger lungs. In the smaller lungs, although the blood probably circulates more rapidly through them and the breathing is quicker to compensate for the want of space, yet it seems impossible, other conditions and circumstances being the same, that the blood can as completely unload its excess of refuse and receive its full cargo of oxygen as it can in relatively larger lungs. The smaller lungs, too, are more likely to be overtaxed, and are more liable to

congestions. Many of this class of persons exercise their lungs to the full capacity, and with hygienic care live on to advanced age, in fair, though not in vigorous health ; yet as will be presently more clearly shown, they are more liable to consumption than persons in whom these organs are better developed. Many of the class, on the other hand, do not, from habit or other cause, fully expand and use the small lungs they possess; and hence a condition eventually even worse than in those with imperfectly exercised larger lungs.

Children born with relatively small lungs are found to have usually, along with other characteristics, a more or less puny constitution, with a tendency to "shortness of breath" and palpitation of the heart, and to be "thin in flesh." With favorable surroundings and habits, they survive the period of infancy and childhood, and in fair health. They may live so through the period of school life with its inspiring, lung-expanding plays and games; sometimes manifesting great mental ability, as if to make up for want of physical power. So long as the respiratory capacity is not overtaxed by tissue change—by labor or exercise, if the skin be kept active and, above all, only pure air be breathed, such persons may enjoy good health to the full average of life. During the closing years of adolescency, however, at that maturing and somewhat delicate period of life when consumption gathers in its largest harvest, it may be from a want of the inspiring exercises out of doors, or from "over study," so-called, indoors, or from too

much physical labor in unventilated working places, respiration, naturally not vigorous, becomes more and more inactive and imperfect, the lungs and the blood become foul, tubercle bacilli are inhaled, and eventually tubercles are formed in the lungs. If now, because of the symptoms to which the tubercle gives rise and the consequent awakening, anxiety or alarm, proper remedies be employed, the tubercular process may be arrested and fair health restored: if not, another death from consumption is eventually the consequence.

SPECIAL COLLECTIVE INVESTIGATIONS.

Over twelve years ago, through the courteous aid of a number of the leading medical journals, I sent out to practising physicians in the United States and Canada a series of questions, with blanks for replies, respecting the causes of consumption. Replies were received from physicians throughout many of the Northern States and the Dominion of Canada, and much valuable information was obtained relating to the personal history of a large number of consumptives. The replies showed that in all the cases reported upon, the chest dimensions were less than the average of well-developed individuals of the same height and weight, as given by the best authorities (as in table, page 36); the average of the cases being in fact only about five-sixths of the dimensions demanded by healthful development. The measurements had been doubtless taken after the disease had made considerable progress; but the reduction of the measurements by the tissue waste characteristic of the disease

would hardly have been more than three or four inches in each case, or not much more than half of the five-sixths shortage.

In October, 1882, a pamphlet was published, giving the results of my investigations in this way, from which the following is quoted: "One of the most marked features, and perhaps the most important one, brought out in the analyses of the cases reported, is the evidence that those who die of the disease under consideration have a proportionately small pulmonary capacity—a small, contracted chest. This is shown not only in the average of the cases, but in every case: in not one did the circumference of the chest closely approximate that of a well-developed individual of the same height and weight. According to the best authorities the circumference of the chest around or on a level with the nipples should be, for good development, equal to one-half the height, plus one-fifteenth the height, of the individual. The circumference of the chest, therefore, of one whose stature is 5 feet 5½ inches—the average height of the cases reported—should be, according to that, at least 37 inches; whereas the average circumference of the chest in these cases was only 31½ inches, or about five-sixths of that demanded by good natural development. In about half the cases the chest was reported as flat, as well as small in circumference, a form giving still less capacity than a round chest with the same circumference. It may be fairly assumed that the average length of the cavity was not greater than in well-developed persons. In the larger proportion

of cases the trunk was reported as proportionately long, but probably owing to a long abdominal cavity; as in most of the cases the function of digestion appears to have been usually well performed.

"Now, although small lungs may be more highly organized than larger ones, as often is the case with other organs—the air cells in the small lungs may be, relatively, more numerous than in larger ones, and so give a relatively greater respiratory surface—we have no evidence that this is the case, and although this condition might prevail to a certain extent, there was, doubtless, in all these cases a marked want of capacity for the purpose of carrying on, in a perfect manner, the important function of respiration. There would be, consequently, in such circumstances, besides want of personal stamina, from want of oxygen for active tissue metabolism, a tendency to accumulations in the blood and other fluids of the body of waste, used-up matters, and frequently probably, too, of unassimilated though perhaps digested food, especially of the carbonaceous class. . . . The patients had been nearly all small or moderate eaters, and had used but little fatty food except butter. They could, for the most part, apparently readily digest all the system could utilize with its small respiratory capacity.

"Why, it may be asked, should persons with small lungs most readily fall victims to consumption? Many more persons, we cannot doubt, take into their bodies the germs of consumption, the bacilli, than manifest symptoms of the disease: just as, doubtless,

in the case of other infectious diseases. Besides the exciting cause of any infectious disease, there must be, before the disease can be developed, a predisposing cause—the seed must have favorable conditions for its development and multiplication. . . . In a healthy, vigorous, clean constitution the germs are harmless, and are probably soon destroyed, or expelled from the body by the excretory organs."

During the next few years after these investigations I gave a good deal of attention and study to this factor, a respiratory want, in the causation of consumption, becoming yearly more and more convinced of its vital importance. In October, 1889, at the Convention in Brooklyn, N.Y., of the American Public Health Association, in a paper which it was my privilege to read at one of the meetings, I brought this special subject forward and urged the desirability of making practical application of the suggestions which it involved when employing measures for the prevention of consumption, instead of confining our chief attention to, and directing almost our entire forces against, the tubercle bacillus.

EXPERIMENTS AND OPINIONS OF OTHERS.

There are others who have given attention to this subject, and who, from their recently expressed views, appear to entertain opinions similar to my own, especially in respect to the principle involved, as shown in the following extracts.

In March, 1890, Doctor Stephen Smith Burt (at New York Acad. of Med.) said, "An acquired inse-

curity from the pathogenic germ [the tubercle bacillus] is due to innumerable causes which conspire to lower the tone of the system in general, and of the lungs in particular. One source of structural weakness which has especially impressed me is that the waste products circulating through the organism are ofttimes not properly oxygenated on account of defective respiration, and these form an attractive field for the harmful bacteria; whereas, a thorough daily bath of the tissues in well-purified blood consumes the ptomaines, and by keeping the cells of the body in a sound condition, starves the germs that have chanced to gain admission."

In a little book by G. W. Hambleton, M.D. (Pres. Polytechnic Phys. Develop. Soc., Gt. Brit.), which has attracted some attention, the preface of which is dated April, 1890, at London, the author writes: "I have experimentally produced consumption [?] by the reduction of the breathing surface of the lungs below a certain point in proportion to the remainder of the body. . . . On one occasion I took a well-developed chest, and gradually submitted it to conditions that tend to reduce the breathing capacity, and at the same time, so far as possible, placed impediments to the performance of compensatory action by other organs. At first there was a reduction of the chest-girth, a wasting of the muscles, a loss of the range of extension, the well-known change in shape, and increased frequency of breathing. This was soon associated with catarrh, pain in the chest, steady loss of weight, and hectic:

and the process was continued until I was satisfied that consumption was well established [?]. Then I induced compensatory action by other organs, and submitted the lungs to conditions that tended to develop them. This was followed by great relief in the chest symptoms, which eventually disappeared by a restoration of the general health, a return to the normal weight, a change in the shape of the chest in an opposite direction; and I continued the process till the chest had regained its full development, and there was sound health. Each step in the experiments was carefully verified, the same sequence of events was invariably observed, and I have both traced the presence of these conditions and watched their progress in many cases of consumption."

But few probably would approbate Doctor Hambleton's experiments in their entirety. He had, doubtless, implicit faith in the certainty of his remedy. Doctor Hambleton is one of the very few who do not yet recognize the generally received theory that the bacillus tuberculosis is an essential factor in the causation of tubercular consumption. His theory, therefore, that consumption is solely produced by conditions that reduce the breathing capacity below a certain relative point, is not likely to receive general recognition. But, and although he does not inform us whether in the cases of his experiments, when "consumption was well established," there were bacilli in the expectoration, his experiments are nevertheless of considerable value, in showing the effects of a limited respiratory function.

J. Edward Squire, M.D., M.R.C.P., etc., Physician to the N. London Hospital for Consumption, in a recent book (Hygienic Prevention of Consump., '93. London: Chas. Griffin & Co.), gives the following table showing "the average quantity of air expired after a full inspiration, for different heights, in health, compared with that which can be expelled by persons of similar height in the early stage of phthisis:

Height.	Health.	Early Phthisis.
5 feet 5 inches.	214 cubic inches.	143 cubic inches.
5 " 6 "	222 " "	149 " "
5 " 7 "	230 " "	154 " "
5 " 8 "	238 " "	159 " "
5 " 9 "	246 " "	165 " "
5 " 10 "	254 " "	170 " "
5 " 11 "	262 " "	176 " "

This points clearly to a limited respiratory capacity before the commencement of the disease.

No medical fact is better known, even beyond the limits of the profession, than that a sedentary life with a stooping, lung-contracting posture, stands high in the list of causes of consumption; and also that those with a narrow, flat chest are much the more prone to the disease. Why?

Again, we find the latest authorities, specialists in chest diseases as well as others, so far as their views can be obtained, universally recommending chest expansion, and so increase of lung surface and respiratory capacity, as one of the most important, if not *the* most important, of all remedial measures; indeed an absolutely essential one, as well as the first of

preventives. The pneumatic chambers of various kinds now coming into use in the treatment of the disease, with other mechanical contrivances, and the various gymnastic exercises have, in the main, the same object, increase of lung surface for respiratory purposes. The advice to "keep out of doors," or to "live in the open air," in order to get the utmost benefit from the pure air—the greatest proportion of oxygen, for both invigorating and purifying the body—has also the same object, and long and ever commanded first place in the list remedial. Again, Why?

Von Ziemssen, the high German authority already quoted, after giving much the usual list of causes of tuberculosis, says, "Of all these none are so powerful to weaken the resistance of tissue cells, as the lack of fresh air and the insufficiency of out-door exercise." The effects can be best studied in the "inmates of prisons, asylums, convents," etc., the air in the "closed rooms" of which "is not pure," "is poor in oxygen but rich in carbonic acid" (like what it is in the stagnant air of the air chambers of the lungs in imperfect shallow breathing). "On account of the sedentary life, the respiration is not deep enough and the lungs are not well expanded," Von Ziemssen continues. He describes the "paralytic thorax," or chest;—flat, with "slight elevation of the walls in inspiration." In the treatment, fresh air occupies the first place. . . . "The patient should practise deep inspirations," as by "climbing any hill or mountain," or by "regular gymnastic exercises."

Thomas J. Mays, M.D., Philadelphia (in Pulmon.

Consump. a Nervous Dis. Detroit: Geo. S. Davis), after referring to defective expansion of the apexes of the lungs as being a cause of tuberculosis so often commencing there, says, "This explains why those who follow in-door occupations, who habitually become stoop-shouldered and flat-chested, furnish such a large contingency to the army of consumptives." Respecting the treatment, he recommends "the inhalation of oxygen, nitrous oxide and compressed air," and the practice of "pulmonary gymnastics."

N. S. Davis, jr., A.M., M.D. (Prof. Med. Chig. Med. Col., Phys. Mercy Hosp., etc.), names the following, and in the order given, as the four commonest causes of acquired predisposition to consumption: Breathing of closely confined air: lack of necessary muscular exercise: use of food that is not wholesome: possession of other diseases of the lungs and tubes. Lack of exercise "prevents frequent and deep breathing." "If air be allowed to remain too long in the lungs it becomes over-filled with waste matter and ceases to purify the blood; then all parts of the body begin to feel the lack of the invigoration which an abundance of fresh purifying air will give to the blood, and through it to all the tissues. . . . A person quietly standing or sitting breathes less per minute by several inspirations than one who is walking or otherwise exercising. In addition to breathing less frequently he breathes less deeply." In both ways the amount of air breathed "is made to fall below the standard." When the body is bent and the shoulders sag forward, "the amount of air entering and

escaping is plainly greatly lessened. A considerable part contained in the lungs is stagnant. . . . Of special exercises the most important are those that expand and enlarge the chest and insure thorough ventilation of the lungs with clean air. . . . An erect carriage should be striven for. . . . In order to expand the chest nothing is so important as . . . enforced and frequent deep and slow inspirations and expirations. The necessity for such exercises cannot be too greatly emphasized. . . . Deep breathing causes better oxygenation of the blood. . . . The entire lung capacity should be brought into use. In those parts where the air is rarely changed, waste matter that should be exhaled accumulates. If disease exists near, products of the action may be re-absorbed, and prove poisonous to the body." In concluding, in respect to different forms of exercise, on which he dwells, Doctor Davis adds: "With all these exercises it is best to combine systematic and enforced deep breathing" (Consump.: How to prevent and how to live with. Phila.: F. A. Davis, Pub., '91).

J. Edward Squire, M.D., etc., London, in the work above quoted from, remarks,—"The proper development of the chest is especially important in those with a phthisical tendency." Proper carriage "does much to throw out the chest and increase its capacity. . . . A most important effect of muscular exercise is that produced on the lungs. . . . The quantity of air inspired and of carbonic acid eliminated is thereby greatly increased. . . . Muscular action requires unimpeded respiration. . . . Many exercises may

be useless or injurious. The chief aim should be to expand the chest and increase the respiratory capacity of the lungs. . . . I am confident that much benefit would be derived by those with narrow chest, round shoulders and a constitutional tendency to consumption by a special course of Swedish exercises."

Chas. Denison, A.M., M.D., etc., of Denver, already quoted, who has had exceptional experience in the disease under consideration, asks, "Why is it that consumption is so often 'of the lungs'? Is it because of the non-use of certain portions of the lungs? . . . Is it because the ordinary breathing of sedentary people removes a tenth at a time of the air the lungs contain, and those portions farthest from the large tubes are so little disturbed that they become vitiated and retractive in the self-poisoning process through which the individual passes? Is it because the bacillus of tubercle needs some such vitiated climate, be it the stagnant, imprisoned air or the chemically changed secretions, in order to multiply most prolifically? . . . Settle this question . . . as you will . . . you must come to the decision that it is *natural elimination* which is interfered with, and it is *healthful respiration* which is wanted. It is action as opposed to stagnation."

Austin Flint recommends "increased expansion" and "forced efforts of expansion" of the chest in the treatment of phthisis.

Finally, H. Weaver, M.D., in a late number of the New York Medical Journal, brings out the point very clearly when he writes,—"Every cure of phthisis

is the result of an increased respiratory activity and capacity, which is directly antagonistic to the development and extension of the disease. . . . Increased vital capacity is the great desideratum without which there can be no cure of phthisis." By vital capacity I take it that Doctor Weaver means respiratory capacity. He quotes Doctor T. J. Mays as showing that "apex expansion or ventilation is the most important factor in the cure of incipient phthisis;" a condition "promoted by the highly attenuated atmosphere of high altitudes." The whole of the lungs must there be used in order to supply the required oxygen, there being less of this element, bulk for bulk, in the thin mountain air.

In bovine animals we find evidence of the correctness of my theory and contention—that a defective respiratory function is an absolutely essential factor in the causation of consumption. We find those animals bred more especially for the development of the glandular system—for yielding an abundant supply of milk, rather than for robustness or vigor of constitution, with well-developed respiratory organs—those animals with a relatively small chest, and in which the lungs are not much, or never fully, exercised, as by a run in the fields, are usually, if not always, the ones which succumb to tuberculosis.

What does all this signify and teach? Does it not clearly and impressively declare that there is in consumptives, all, a want of sufficient, healthy, active lung surface for the purposes of respiration—a want of oxygen, with a consequent accumulation in the body of waste, dead matter?

CORROBORATIVE EVIDENCE.

In cases in which, in certain occupations, consumption is caused largely, primarily or remotely, by dust, the cilia are overtaxed, particles get into the air chambers, and the walls of the chambers from the irritation set up become thickened, and the respiratory function curtailed. Besides, persons working in a dusty atmosphere almost instinctively avoid deep, full breathing, and rarely fully expand the lungs.

Another point bearing upon this question relates to the "intimate association" existing between pulmonary disease and the nerves controlling respiration: the vagi nerves, one (a vagus) on each side. This subject is fully discussed by Doctor Mays in his treatise, already named. One can easily understand that any disease or injury of the nerves of an organ will influence its function, and that the respiratory function is injuriously influenced by disease or injury of the vagi nerves, as clinical observation and experiments on animals clearly prove. The first case reported by Doctor Mays, that of Mrs. W., who manifested "uncommon nervous symptoms," early showed "want of proper expansion," and "diminished respiratory motion" of the chest and lungs, supports my theory. So, too, does the fact brought out in his tabulated history of cases, that "division, injury, or acute disease of the vagi always resulted in œdema, hyperæmia, hæmorrhage [swelling, congestion or bleeding] or bronchitis, but never in phthisis—the last disease only being produced when the vagi were subjected to a slow process

of devitalization such as would take place from long-continued pressure or protracted disease of the nerve." Here the "injury" or "acute disease" would quickly affect the respiration: the "slow devitalization," gradually curtail the respiratory function, producing the slow poisoning process necessary for the production of the tubercular soil. It seems possible, too, that a stooping curved position of the chest and shoulders might cause such pressure on the vagi nerves at the base of the neck, where they are so near to the firm walls of the large arteries, as to interfere in a measure with their perfect function.

There is yet another point, the consideration of which also appears to give support to my view. For centuries the breathing of already over-breathed air has been looked upon as a most common and prolific cause of consumption, as already intimated. This is so generally recognized that authorities need hardly be quoted here: this one will suffice. In his "New Medical Dictionary," Geo. M. Gould, B.A., M.D. (Philadel.: P. Blakiston, Son & Co.), writes, "Among yet undetermined leucomaines are bases known to exist in expired air. . . . The same violent poison is said to produce pulmonary phthisis in confined air by continuous influence."

It is well known—the records of mortuary statistics proving beyond doubt—that the death-rate from consumption is much greater in the poorer parts of cities where the dwellings are overcrowded than in the less crowded parts. It was shown last year at the Academie de Medicine, Paris, that one poor district in

that city, the Plaisance, had a death-rate from this disease nearly ten times greater than the Champs Elysées. This difference is due in a measure to other causes—want of sunlight, improper food, and the spread of the disease by infection: but unquestionably the principal cause is the breathing of over-respired air in small, close and crowded rooms,—imperfect respiration.

It need hardly be said that the habitual breathing of an over-breathed atmosphere, outside the body, with its reduced proportion of oxygen, excess of carbonic acid and organic poison—the "undetermined leucomaine"—gives rise to the same body condition, in a degree, small or greater according to circumstances, as the stagnant, largely unchanged atmosphere in the air chambers within the body, arising from shallow, limited breathing.

Finally: it may be asked, how is it in cases of consumption which are practically cured without special out-door or lung-expanding treatment, occasionally in a city hospital? May it not be somewhat in this way: symptoms being usually nature's benign efforts towards health, and cough being a symptom curative in design, it eventually not only expels irritating substances on the surface of the air passages, but also acts as a forcible distender of the lung membrane and air chambers: acts practically in a measure as do lung gymnastics—stretches and attenuates the air chamber walls, increases the respiratory capacity and improves the function? The act of coughing is unquestionably remedial, and in certain cases, as in persons with a good history—no hereditary taint,

under the improved surrounding conditions in a modern well-ventilated ward, the best of nutrition, antiseptics, and perhaps skin-cleansing and stimulation, the cough, with these remedies, at length gives rise to a reaction, or the turning-point toward health, and the cure which finally comes about.

WHAT MAY BE SAID AGAINST THIS VIEW.

It may be said that some persons die of consumption who have a well-developed chest. So far as my observation and experience have gone, they are muscular persons, perhaps even with a tendency to lay on fatty tissue, and, withal, a chest measurement large in proportion to the size of the lungs; in other words, the lungs are not so large, perhaps not nearly, as one might naturally suppose them to be. Besides, it is possible that the lungs of such persons are less highly organized, have larger air chambers and fewer of them proportionately. Some persons, too, with well-developed lungs have a habit of very shallow breathing; while the skin is often also neglected.

Again, it appears there are a few so-called "athletes" who habitually for a time fully, probably over, exercise their fairly developed lungs, yet who fall victims to consumption. It will be found that in such men, while the lungs are fairly well developed they are not sufficiently so to bear the strain of the excessive amount of labor thrown upon them by the perhaps violent general bodily exercises indulged in, as of rowing, base-ball, etc., possibly thrown upon them suddenly at the beginning of the exercises: the train-

ing, especially at the commencement, being bad, the lungs are unable to perform, without strain, the extra respiratory work demanded of them by the increased general muscular action. They consequently break down. Hæmoptysis (spitting of blood from the lungs), if not more profuse bleeding, is the probable consequence. The bleeding is probably not caused by tubercle. Eventually, however, with the consequently restricted respiratory action and capacity usually following this condition, tubercles are formed.

RESPECTING CAUSE AND EFFECT.

There are scientific physicians of high standing who do not yet believe that the tubercle bacillus is the cause, or a cause, of consumption; but that it is always present as a consequence. The truth appears to lie between the two views. The bacillus will not grow and multiply in the body, or the tubercular matter characteristic of the disease be produced, unless there be already in the body a certain condition or substance—a "soil"—practically and actually body derangement—disease. As a limited respiratory capacity seems to invariably precede the tubercular state, what explanation so natural and reasonable as that this deranged condition of body—this so-called soil—results from excess of waste—debris of tissue wear and combustion—accumulated in the body by reason of the imperfect respiration? This waste in decomposing would doubtless give formation to such inorganic elements as would be suitable food for the vegetative microbe. And as something more than simple food

seems necessary to give rise to the virulent pathogenic action of the microbe (else most likely more persons would be affected by it and it would not remain in the body in a dormant state or be found in a harmless condition), the decomposition of the excess of waste, in the absence of abundance of oxygen, too, also gives rise to some more special soil-fitting substance, plus the inorganic food elements; something toxic to either the body fluids and tissues or the bacillus, or to both, and which transforms the bacillus into virulency: somewhat as the bacillus coli communis is transformed by "cultivation" in "fecal solutions"; or as other toxines sometimes formed in the body, it appears, give rise to headaches, "malarial" symptoms and even epileptiform convulsions, possibly, too, through the action of micro-organisms.

While, on the one hand, then, there can be no tubercle without the tubercle bacillus, so, on the other, it seems probable there can be no tubercular consumption without the previous excess of waste in the body from imperfect respiration. The bacillus is a natural organism; the defective breathing and excess of waste in the body constitute an unnatural condition, which exists previous to, and seems to be the cause of, the virulent action of the bacillus: if so, this abnormal condition, rather than the bacillus, is the actual exciting cause of consumption, an l in preventive action, demands first consideration. Moreover, were these bacilli at once all annihilated, those persons predisposed by such condition to harbor them, would not probably remain long in any better state than if

subject to the depredations of the bacilli; other germs would most likely soon invade the inviting field: a point to be again touched upon.

CONCLUDING FACTS AND DEDUCTIONS.

What are the now generally recognized facts which bear upon this subject? They appear to be, briefly, about as follows:

1. That the tubercle bacillus is an essential factor in the production of tubercular pulmonary consumption.

2. That the tubercle bacillus does not become a cause in the production of the tuberculous state, except in a special condition of the human body—in what is termed a suitable soil.

3. That the tubercle bacillus, being ubiquitous, is doubtless often received into the human body, and is apparently sometimes retained there an indefinite time and yet produces no ill effects, because the body condition—the so-termed soil—is not then suitable for its virulent or pathogenic action.

4. That this apparently quiescent, non-virulent state of the yet living bacillus cannot be satisfactorily explained on the supposition of an immunity by reason of phagocytic action, or bactericidal properties of the blood serum; nor especially can the later activity and virulence of the bacillus, on the supposition of only weakened phagocytes or want of the serum antidote.

5. That the virulence of pathogenic micro-organisms may be and is increased, and benign micro-

organisms rendered pathogenic, by certain special circumstances of condition or environment; or, in other words, and more definitely, by being brought in contact with, or under the immediate influence of, certain substances, perhaps in a measure toxic, in either a living animal body or outside of it, as in certain decompositions of excremental matter in the case of the bacillus coli communis.

6. That certain substances, such as ptomaines and other toxic combinations, are formed in the human body by the chemical or physiological changes or decompositions which take place therein in accumulations of used-up, dead, excrete matters; and doubtless these toxic substances exert an influence on micro-organisms, whether benign, saprophytic or pathogenic, which are present in the body.

7. That a want of full proportional breathing surface or action necessarily gives rise to accumulations and excess in the fluids and tissues of the body, as well as in the lungs, of used-up, effete products of the functions of life, which, with full respiratory action, would be thrown out.

8. That as oxygen appears to neutralize or destroy the effects of ptomaines in the body, and probably prevents their formation, the want of oxygen consequent on a defective respiratory function, doubtless favors the production of intoxicating ptomaines from accumulations of the waste products of life.

9. That, therefore, persons with defective respiratory action from any cause are more liable to have

toxic substances formed in the body; and which probably influence the action of micro-organisms present therein, including tubercle bacilli.

10. That the action of the bacillus, which results in the formation of tubercle in the lungs, seems to be invariably associated with a want of full proportionate breathing function in the individual affected; or, in other words, the so-called soil for the pathogenic action of this bacillus in the lungs seems to be invariably furnished by persons with a defective breathing function, as particularly evidenced by the success of the "out-door" or "pure-air" treatment of the disease, with special lung expansion for increasing the breathing function, almost universally recommended.

It has been my endeavor not to take a narrow view of this question, and I do not advance the theory that a defective respiratory function is the only cause of consumption; but in consideration of all the facts it is a fair and reasonable inference that in persons with this function reduced below a certain relative or proportionate healthy limit, there are eventually accumulations in the body of waste, dead matters, the decomposition of which, while probably providing inorganic food elements for the tubercle bacillus, also at the same time gives rise to a certain toxine, which, either directly or through the tissues, so affects the bacillus as to render it poisonous and destructive of even fairly or practically healthy tissue.

The formation of tubercle in parts of the body other than the lungs would readily arise in the same manner, from the same cause; the germ food elements

and exciting toxine pervading the entire body. The disease would be, however, naturally less frequent in other parts than in the lungs, the immediate seat of the defective function and source of the exciting cause.

Have I not now fairly demonstrated, on the strongest circumstantial evidence, as intimated in my pamphlet of thirteen years ago, that a defective respiratory function with the consequent retention in the body of waste or excrete substances and the toxic compounds generated thereby, is the actual, immediate or exciting cause of consumption? It can hardly be doubted that, imperfect breathing—defective respiration—gives rise to excess of waste products in the blood and tissues; that the waste products decompose and give rise to toxines; and that the toxines cause general bodily depression—languor, even want of appetite with dyspeptic symptoms, and, eventually, loss of body weight,—the too familiar pretubercular state. This condition is brought about slowly in many cases, more quickly in others. What more fitting condition, or soil, than this for the action of the microbes, or so-called germs, so far as we now know the nature of these? What condition more likely to cause dormant, non-virulent microbes, or saprophytes, to become virulent—rapacious—parasitic, pathogenic?

The other causes, yet to be discussed, for the most part, but favor imperfect breathing.

CHAPTER V.

CAUSES OF CONSUMPTION CONTINUED.

HEREDITY AS A CAUSE.

GENERAL REMARKS.

THE subject of heredity is one which has been in a large measure misunderstood, or about which there has been much miscomprehension. Some hereditary influence has long or "always" been regarded as a cause of consumption. Take almost any case of the disease in a man or woman in early or middle life, and ask a hundred neighbors the cause of it, referring to that particular case, and nearly every one of them will reply, in effect, that it was inherited. And it is undeniable that the disease is more common in certain families or strains than in others. As already has been stated herein, however, less importance is now attached to heredity as a cause than was formerly the case.

Previous to the discovery of the tubercle bacillus, heredity was supposed to be limited to the so-called predisposition or susceptibility—to some sort of "idiosyncrasy"—a peculiarity of constitution or temperament, to that condition now regarded as a fitting soil for the growth of the bacillus. Even then, however, children of consumptive parents were said to

inherit the "seeds of the disease": yet this doubtless without any specific or particular seeds, as now known and understood, being generally even suspected as a cause. Since Koch's discovery the question has been much discussed as to whether or not it be possible or common for the bacillus or its spores to be directly communicated by the parent to the offspring. Can the specific living germs, the so-called seeds of the disease, be inherited?

After giving some statistics relating to heredity in general, we will consider the subject in its two phases: first, the influence of heredity, as it relates to the transmission of the bacillus itself; and, second, as it relates to the predisposition or idiosyncrasy.

STATISTICS BEARING UPON HEREDITY.

Statistics, for the most part, aside from reports of actual events, as births, deaths, etc., are often fallacious and misleading, and but rarely interesting, or only interesting to a small minority of persons. It will be well, however, to give a few here in order to illustrate in a general way the extent of hereditary influence. Statistics bearing on this subject show on an average that in about one-third of the persons affected with consumption there is a possible chance that it was in a measure inherited from parents.

Mays, in his work already referred to (Consump. a Nervous Dis.), quotes interesting comparative statistics from the report of the N. Y. Mutual Life Ins. Co., for 1877, which show that, of 1,031 cases of consumptives and an equal number of non-consumptives,

there were among the former 194, and among the latter 102 family members who were tainted with the disease. It may be observed in respect to these, however, that if an equal number of other persons of each class were selected, quite different results might possibly be deduced.

Williams (Pulmon. Consump.) mentions 1,000 consumptive cases of the Brompton Hospital Report, including only heredity from parents, which gave an average of 24.4 per cent. in which there was hereditary influence; 385 cases by Doctor Fuller, embracing also grandparents, uncles and aunts, which gave 59 per cent.; 1,000 cases by Doctor Cotton, embracing parents, brothers and sisters, which showed 36.7 per cent.; and 1,200 cases by Doctor Pollock, similarly estimated, showing 30 per cent. Doctor Williams' own cases, 1,000 in number, on the same basis as the latter, gave a percentage of 48.4.

Squire, in his recent work, already quoted from (Hyg. Prevent. of Consump.), makes the following statements respecting cases of his own: "The figures obtained in the ordinary manner probably give far too high a proportion in favor of heredity. To take a few illustrations from my hospital case-book: Out of 500 consumptive patients, one or both parents had been consumptive in 154 cases, showing possible heredity in 30.8 per cent., and no phthisis in the parents in 69.2 per cent. This gives a possible chance of heredity in about one-third of the cases; and this amongst hospital patients whose mode of life is unfavorable and unhygienic. In 250 of these cases,

in which the family history is more fully stated, one or both parents were consumptive in sixty-two cases, or only 24.8 per cent. In these sixty-two families the total number of children amounted to 374, of whom 108 became consumptive—again about one-third. Here we are only dealing with families in which consumption has shown again in the second generation, so the proportion is higher than it should be: for if we could include the families of consumptive parents where all the children have escaped the disease, the number of individuals would be increased whilst the number of consumptives would remain the same.

"In the above sixty-two cases, the father was consumptive in twenty-eight cases, and these twenty-eight families contained 185 children, of whom forty-three became consumptive, or about one in four. In twenty-four other cases the mother was consumptive, the total number of children was 152, of whom forty-seven became consumptive, or nearly one in three. In the remaining ten families both parents were consumptive, the total number of children was thirty-seven, and of these eighteen, or nearly one-half, became consumptive.

"This is a small number of cases on which to found general deductions, but they seem to show that where the mother is consumptive, the hereditary tendency to the disease is slightly more intense than when the father alone is phthisical. When both parents are consumptive, not only is the number of children much reduced, but the hereditary tendency is increased. Against the theory of hereditary predisposition in

these cases we have to remember the closer connection of the mother with her family both in infancy and in sickness;"—and a possible chance of infection, he doubtless hints at.

Some statistics have shown that nearly twice as large a proportion of consumptives have tuberculous brothers and sisters as have tuberculous parents. This of course points to other causes—habits and conditions of life and probably infection.

The following concluding quotation is from my own pamphlet, published thirteen years ago, already referred to (Etiolog. Statis. Rep. on Causes of Consump.): "It appears, therefore, that any special influence or matter of a direct or specific hereditary character, as a factor in the causation of consumption in adults, or even in youths, is not of such constancy and importance as has been commonly supposed. In only little more than one-half (53 per cent.) had any relatives been known to have died of the disease; and in not much more than one-third (36 per cent.) had any ancestors—parents or grandparents—died of it. More than this in favor of heredity could doubtless be said of scarlet fever and measles. But, in so far as configuration and structure of the body and the relative size and vigor of different organs are influenced by parentage, hereditary influence becomes an important causative factor. Indeed, heredity probably has no direct influence whatever at the periods of life above mentioned other than in this way.

HEREDITY AS RELATING TO THE TUBERCLE BACILLUS.

On this point of the subject there is still a difference of opinion. The greater weight of authority is altogether on the side of those who believe that the bacillus may be, but very rarely is, transmitted from parent to child, and that the infant may come into the world with the actual living germ already in its tissues. There seems now to be the most convincing evidence of this. As Ziemssen has said, the great difficulty connected with the question lies in the "*long latency of tuberculosis in childhood*"—its long dormant or concealed state. Baumgarten, it is said, has in the case of the rabbit observed the bacillus within the ovum; and Jonne, of Dresden, in an unborn (fœtal) calf of seven months intra-uterine (in the womb) growth, found numerous tubercles, showing that if the ovum had not been infected, the bacillus must have passed through the placenta (after-birth) of the mother. Again, it appears that experiments of inoculating healthy animals with juices of unborn animals from tuberculous parents have been made which favor the view that the bacillus or its spores may pass from the mother to the unborn offspring. Solles believes that direct hereditary tuberculosis exists by means of the sporules passing in this way. In 1891, Birsch-Hirschfeld reported the case of a woman dying of acute general tuberculosis at the end of the second month of pregnancy: careful examination revealed numerous tubercle bacilli in the afterbirth; and portions of the liver, spleen and kidney of the unborn offspring transplanted into the abdominal

cavity of guinea-pigs and rabbits produced undoubted tuberculosis. Baumgarten, in a more recent article, supports the view of direct hereditary transmission, and claims that the bacillus is present at birth in many of the children born of tuberculous parents, but that it is latent, and "its future history is dependent in a great measure upon the favorable or unfavorable condition of the soil offered by its host." It may in time, he thinks, "lose its vitality;" or, on the contrary, under depressed conditions of the system, "take on luxuriant growth." A conclusive case, observed by F. Lehmann, has been recently published (Berl. Klin. Woch., July 9th, '94: Brit. Med. Jour., Dec. 1st, '94). A mother, aged 40, who had been long phthisical, gave birth to a child, and died on the third day thereafter. The lungs "showed old tuberculous disease and miliary deposits." The child died twenty-four hours after birth. Its lungs, bronchial, mesenteric and other lymphatic glands and a kidney were tuberculous.

Birsch-Hirschfeld, and, later, Kockel and Lungwitz are inclined to the view that the way in which the bacilli pass from the mother to the fœtus is by "growing through" the after-birth; *i.e.*, apparently, by the gradual spread of the disease through it.

On the other hand, Davis, quoted on a previous page (Consump.: How to Prevent, etc.), says, "From the facts gathered, we must conclude that the bacilli are not transmitted to offspring by tuberculous fathers, and that, while it is possible for such transmission to take place from tuberculous mothers, it

occurs with the greatest rarity. The disease is hereditary, because there is transmitted a predisposition to it, not the bacillus tuberculosis." Professor Blackader (McGill, Montreal) says, "Pathologists now tell us that heredity in this form is the very rare exception. In the vast majority of cases heredity in tuberculosis signifies only an excessive hospitality for the tubercular microbe, or a deficient capacity for dealing with it on the part of a too feeble phagocyte. . . . It may be said, that the view generally held is that cases of true heredity are extremely rare, but that instances may occur, as where the mother is suffering from general miliary infection or from definite tuberculous disease of the genital system." Epstein, in two hundred infants under one year of age, of tuberculous parents, could not find, upon examination, signs of tubercle in one. In respect to animals, Osler (Practice of Med.) states that, "although, in Berlin abattoirs for some years past, 13 per cent. of the animals slaughtered were tubercular, out of 15,400 calves killed, only four were found similarly diseased." Professor J. E. Graham (Toronto University) asserts that the baby guinea-pigs of tuberculous mothers are never found to be affected; and at a large maternity hospital in Paris (Clin. d'Accouch.), post-mortem examinations were made in all cases of death of premature or fully developed children during a period of eight years, and tuberculosis was never found; nor had inoculations made been successful.

It may then be stated that actual heredity in this

sense in pulmonary consumption, as ordinarily seen in youths and adults, is practically not known. In young infants tuberculosis is nearly always chiefly in the glandular system or brain membranes, the lungs being little or perhaps not at all affected. And although the inherited bacilli or their spores may not infrequently lie dormant or latent in the tissues for a long period of time, as some authorities believe, it is not likely they would so lie for years and first manifest virulency in children of even a few years of age.

HEREDITY AND THE BODY FACTOR OR SOIL.

As already intimated, that which is inherited in this disease is usually the constitutional build, or configuration, or the tissue structure, which favors the development in the body of that which enables or incites the bacillus to take part in the production of tubercle. In other words, it is that which gives rise to the so-called soil; or probably, sometimes, the suitable soil itself—the deteriorated, or even foul, poisoned fluids and tissues, and perhaps "feeble phagocyte" cells and weakened germicidal properties in the blood. It is natural for parents to transmit to the offspring peculiarities, even defects, of form and tissue condition, and even of the digestive organs, of the heart, of the lungs, of the nervous system; but it is unnatural for them to hand down to their progeny the actual living germs of disease. It would seem as if nature, abhorring this, stopped short of it, or almost stopped, and permitted it only in a few extreme cases. It is chiefly because of the inheritability of peculiarities and defects of constitution which are in a

measure favorable to the development of consumption that the disease has been long regarded as hereditary. When heredity in this disease, or indeed in any other, is spoken of, usually the reference is made to an inherited tendency to it; which may be very marked or strong, or very slight.

There is a measure of heredity in many, if not all diseases. It is well known, for example, that a tendency to insanity—a defective brain structure—is inherited, and also, to heart disease; or it may be only a proportionately small heart that is transmitted, which by reason of this defect the more readily becomes diseased. Cancer is believed to be, in a measure, hereditary. And some families are much more disposed than are others to "take," and to have in a more virulent and fatal form, even scarlet fever, measles, and the like. It is because of the exceptional frequency and fatality of consumption (fatality usually from early neglect) that heredity in it attracts more attention.

It is, however, certain that, as W. Roger Williams, F.R.C.S., writes it (Brit. Med. Jour., Sept. 22, '94), morbid conditions are never reproduced in the offspring with the same constancy that normal conditions are. "All diseases tend to die out in transmission." "So great is the preponderating influence of the previous ancestral balance that even in families where hereditary tendency to disease is strongest, most of the members usually escape."

The influence of heredity as bearing more especially on this part of the subject is summed up from opinions

of "leading biologists" by Doctor George Wilson, in his standard work on Hygiene, as follows (Handbook of Hyg. London: J. & A. Churchill): "The influence of both parents on the bodily constitution of the offspring is manifested in personal resemblances, such as stature, similarity of features, walk, gesture, color of hair, etc. Some of the children may bear a greater resemblance to the father, others to the mother; but it is rare to meet with any instances in which some distinctive characteristics of both parents cannot be traced. The influence of the other more immediate progenitors on the bodily constitution of the offspring is manifested by the resemblances which constitute the phenomenon known as atavism, which may be explained in this way:—A man, for example, does not inherit all the characteristics of either his father or his mother, and of those which he does inherit, only some are developed, whilst others remain latent, and are probably developed in a brother or sister. His son, however, may in turn inherit the same characteristics, but with this difference, that those which were latent in the father become fully developed in him, so that he comes to bear a stronger resemblance to a grandparent or some other relative, as an uncle or aunt, than to his father or mother.—(A Physician's Problems, by Doctor Elam.) The influence of race, or special type, in heredity, is manifested by the constancy of averages, under tolerably constant conditions, from generation to generation. . . . Deviations from these averages or from the normal type, although transmissible, cannot transcend certain limits. As all forms of deterioration or disease may be

regarded as deviations, or perverted life-processes, they are likewise subject to limitation in transmission, and there is the same tendency exhibited to revert to normal type under improved conditions. Thus, all chronic diseases appear to be transmissible either as a morbid tendency or in their general form, such diseased heritage being well exemplified in the case of gout, scrofula, phthisis, syphilis, and insanity; but by adopting suitable measures, the disease may be finally eradicated from the family, or the morbid tendency be overcome. . . . Any particular characteristic, especially if it be of the nature of a deterioration or taint, when common to both parents, is liable to be intensified in the offspring. It is on this account that marriages between blood-relations are inadvisable, inasmuch as latent morbid tendencies, should they form part of the organic patrimony of the family [and only in such case], are almost certain to become developed in the children."

In consumption, the most noticeable and commonly inherited feature is the "flat chest," the proportionately small chest. This is universally recognized. With this defect, the lungs, and hence the respiratory function, can hardly be otherwise than restricted and not sufficiently developed for the needs of the organism. With it, unless it be corrected or modified, too often eventually follow the usual consequences already depicted. With it we usually find the other signs already enumerated herein in connection with the remarks on predisposition,—the slender body and limbs, the delicate tinge, the want of general vigor; sometimes the more intense, "scrofulous" condition—a

tendency to inflamed eyes, an irritable state of the nostrils and upper lip, perhaps a swollen appearance of the countenance and pasty skin, with sluggish, indolent habits: all apparently manifesting a want in the body of oxygen with its invigorating, purifying effects upon the tissues and fluids and life processes.

As already stated, what the precise nature of this predisposition—this germ fertilizer or intoxicant—is we do not yet know. Without attempting to enter further into the subject here with a view of obtaining a satisfactory explanation of it in the present state of our knowledge, or rather want of knowledge, of the remarkably intricate and delicate physiological and chemical changes which take place, and the combinations of matter formed, in all the various processes of life constantly going on in the human organism, in both health and disease, and the relations of these changes and combinations to living micro-organisms, whether benign or otherwise, in the body, the question may be asked,—are the tissues and fluids of the newly-born infant defective, or "debased," from a want of completeness in structure—a want of some necessary condition or element—or do they besides or along with this contain something of a debasing character, some practically foreign, toxic substance, incompatible with perfect, healthy function? The young creature while yet in the mother's womb, is entirely nourished through and by the blood of the mother. If this blood be debased by any impurity or poisonous substance whatever, the blood and tissues of the infant when born will be, doubtless, debased in like manner. As the blood and tissues of the mother are, so will be

the blood and tissues of the infant at birth. This affliction upon the innocent offspring seems hard: yet there is no room to doubt that it may occur. And this indicates the great, serious, indeed criminal, responsibility which may be placed upon imprudent parents. Statistics given by Doctor Squire, recently quoted, show that there were over thirty per cent. more consumptives in the families when the mother was consumptive than when the disease was only on the father's side: yet for many and obvious reasons the father must be held at least equally responsible.

It is, withal, comforting to know that there is a tendency in all defective living organisms to revert —to turn or change back—to the normal, healthy type, indeed, under improved or favorable conditions, apparently a tendency to improvement and greater perfection of type; therefore, all evil hereditary conditions and tendencies may be overcome and practically eradicated, and that, too, in a large measure in a comparatively short period of time.

The principal evil in inherited predisposition to consumption, that of a defective respiratory function, with the usual accompanying conditions, may be, in the less marked cases, often overcome entirely in a few months. By means of proper special exercises in a pure, cool, invigorating atmosphere, with abundance of sunlight, the lungs and chest will gradually and permanently expand, and the respiratory function become more perfect, the muscles of the body and limbs increase in size and firmness, the complexion improve, and the weakly condition of the whole organism will give place to more general vigor. In the worst so-called

scrofulous cases the improvement will not be so rapid and marked, but by proper management, the process of purification and invigoration will go on gradually to the establishment of fair health and vigor. It need hardly be stated that, on the other hand, inherited tendencies to disease may be very easily and rapidly intensified by unhygienic habits of life.

It must be remembered that this predisposing condition, when not in any degree inherited, may be acquired by unhygienic habits and surroundings. It is acquired gradually, and may be originated in its worst form in two or three generations. A few years of one generation may be sufficient to largely reduce the breathing capacity and bring on a train of other evils. An acquired predisposition may be overcome and removed more easily, or in a shorter period of time than that which is inherited.

Any reader, then, who has had relatives die of consumption, and feels, even in a measure, doomed to the same sort of an end, may fairly regard the possession of any possible hereditary taint in the light of simply a timely warning to use reasonable precautions for preventing the disease. With such precautions there is practically no risk of such a life-ending for anyone. It is only those who are indifferent or do not adopt and continue to practise habits of a preventive character who fall victims to consumption.

Yet it must not be concluded that one who inherits the predisposition, however slight, should think lightly of it; it should not, however, be a source of any measure of anxiety; simply an incentive to the exercise of due care of the body.

CHAPTER VI.

CAUSES OF CONSUMPTION CONTINUED. WANT OF THE NATURAL BODY DEFENCES AS A CAUSE.

THE PROTECTIVE WALLS.

THE provisions for the protection of the body from all forms of disease are remarkable. Not the least so are the provisions for keeping out of the body the germs of infectious diseases.

The structure of the outer protective covering of the body—the skin—is sufficiently well known to most persons. Most persons, too, have observed reference to "the skin without and the skin within," and know that the inner cavities of the body are provided with a similar protective covering, or lining. Not only is the digestive canal, from the lips throughout, so provided, but so also is the pulmonary or air cavity. All the bronchial tubes, great and small, and the air chambers, as already stated, have the inner or more exposed air surface of the mucous membrane lining their walls covered over by a layer of cells, called epithelium, similar to the cuticle—the skin's outer layer—except that it varies somewhat in structure (as does this layer in other localities) and is moist and soft instead of dry and hard, as in the case of the skin.

Now, it seems very unlikely that living, disease-producing micro-organisms, infinitesimal as they are, can get into the body through the skin if this be sound —whole, healthy, vigorous and active at every point— if it do not present even in its outer cuticular layer any break, opening or weak spot. Hence, the necessity for a break in its integrity in vaccination. The "pores" of the skin having an action, a sort of current, from within outward, would hardly take in living germs; and should these germs make an entrance, is it probable that they would get through the sweat glands alive? So, also, a perfectly healthy, vigorous layer of epithelium on the skin within will almost certainly prevent the passage or entrance of disease germs into the body. It is believed there must be a break, a want of continuity, in this protecting wall or the germs cannot get through. A few authorities, it is true, believe that germs may pass through apparently healthy epithelium and the other parts of the mucous membrane: as, for example, the tubercle bacillus into the lung structure. On the other hand, high authorities believe differently, and reasonable probability is on this side. Respecting the germs of diphtheria, W. H. Park, M.D., in an exhaustive paper, a "Clinical and Bacteriological Study" of diphtheria (New York Med. Rec., July 30th and Aug. 6th, '92), says, Whether this (the diphtheria bacillus) "can be implanted on the normal mucous membrane in man is still a question. Undoubtedly a lesion favors it. When the bacilli are implanted on the normal mucous membranes of susceptible animals, they do not grow." Doctor A. Jacobi, of New York, says (at N.Y. Acad. of

Med.), "Very seldom does any form of contagion, not even diphtheria, arise without there being previously a broken skin or mucous membrane. . . . Tuberculosis of the intestinal tract almost always gives a preceding history of neglected diarrhœa." He also urges that by reason of the many sources of exposure to the tubercle bacillus, more special attention should be given, especially in the case of children, by both parents and physicians, to catarrhal conditions of the air passages and intestines, sore mouth, diarrhœas, etc.

It is, therefore, easy to see the importance of keeping these protective coverings of the body as intact as possible—in a healthy, vigorous condition. Any break or want of integrity, even a weak spot, especially in the epithelial covering of the bronchial tubes, may open a way for the tubercle bacillus to enter. It is very desirable, too, it may be here observed, to keep the surface of these membranes as clean and active as possible. In the case of the skin, for example, as being more directly under the control of the individual, if it be unclean from want of repeated washing or bathing, disease germs may adhere to it at some point. And here they may lurk, as it were, waiting for an opportunity to effect an entrance. A break in, or a weak or foul—unclean, condition of, these protective walls may therefore become a cause of consumption, in predisposed persons.

THE PHAGOCYTES AND BLOOD-SERUM ANTIDOTE.

When disease germs do get into the deeper tissue structures of the body, whether through a weak spot or break in an investing membrane, or otherwise, if

the body be in a fairly healthy condition, it is not even then all free and unobstructed foraging for the invaders. They are promptly met by a sort of standing army of blood cells, the peculiar protective cells already mentioned in connection with the allusion to the thistle point in the skin. Further, the very atmosphere within, so to write, a germicidal condition or property of the everywhere pervading blood-serum, may depress and weaken the germs.

Four hundred years before our era, Hippocrates apparently first drew special attention to a natural protective and curative force within the human body, applying to it the Greek term, *phusis*, nature; the *vis medicatrix naturæ* of the Latin and later ages. Two and a half centuries ago, the discerning Van Helmont advanced the theory of a more definite power in the body, which he personified as the "*Archæus*," or "Grand Regulator," whose throne was the stomach: Wepfer designated a like power as the "President of the nervous system": and the bold Stahl attributed such an influence "directly and entirely to the rational soul, diffused over the whole body." Only a few years ago, Doctor Elias Metschnikoff (Pasteur Inst.) furnished before our wondering eyes, under the microscope, satisfactory evidence that certain of the colorless blood-cells, or corpuscles, which he termed phagocytes, are special defenders of the body tissues from the inroads of the destructive or specific disease germs. Like other colorless cells, or leucocytes, in the blood and other animal fluids, these phagocytes are microscopic, jelly-like masses, either

globular or irregular in form, indeed often changing their form (amœboid—polymorphous), without an investing membrane, and capable of motion.

In that little animal, the water-flea, may be witnessed actual combats between the phagocytes and pathogenic germs inoculated into the animal. The phagocytes at once attack and devour the intruders, —take them into their jelly-like body and digest them. When a germ is too much for a single cell or phagocyte, others unite—coalesce—with it, and form a larger or "giant cell," which then struggles more successfully with the invader. If the phagocytes overcome the germs, the water-flea lives: if not, the germs soon multiply, overrun the little creature and it dies. In the liver and intestines of birds that have died from tuberculosis, the microscope reveals, within little masses of tubercle, a cluster of minute tubercle bacilli occupying the centre of a giant cell: as, indeed, in the formation and structure of tubercle, as already explained. Doctor J. Bland Sutton compares the action of this cellular army of defence in the body to that of a hive of bees: "When an intruder is small it is quickly stung to death and cast out: when large, after being killed, it is prevented from giving further trouble [as from decomposition] by a covering of wax." Around large foreign substances, tuberculous or other, in the body, the phagocytes often form a dense fibrinous covering or wall which protects the body from further injury by its presence: as mentioned in the discussion on the nature of consumption and the conditions of tubercle as sometimes found in the lungs.

Most authorities now accept the theory of Metschnikoff, although some are of opinion that the actual germicidal or germ-killing power is in the blood, or blood-serum (the watery part of the blood); which when in a healthy condition, they hold, destroys the vitality of the disease germs, while the phagocyte cells act as scavengers and remove, destroy or cast out the disabled invaders, as other leucocyte cells remove other useless or waste excrete matters. The truth probably lies in a measure between these two views. Healthy, "undefiled" blood is, doubtless, unfavorable to the life of disease germs. The experiments of distinguished investigators have made this apparently clear. We know, however, that throughout nature some forms of bacterial germs are actually destructive of other forms, and it is fair to conclude that the higher organized bodies contain within themselves special living structures or cells capable of destroying foreign ones which may gain access into the body. Doctor Adami, of Montreal (Discuss. Internat. Cong. of Hyg., Lon., 1891), says that those who are not in the thick of the controversy (as to the two theories) "must accept both views." It was, he said, "especially around the phenomena observed in the rat" that the difference of opinion had arisen. In the rat, phagocytic action "could be but with difficulty observed, and the rat's blood-serum possessed bacteria-killing properties in a high degree;" and "if we directed our observations aright, it would be impossible not to be struck by the prevalence of phagocytosis." The British Medical Journal (March 26th, '92), in an editorial, says, "There is not the

slightest difficulty in proving, as Metschnikoff has done abundantly, that the amœboid cells of higher animals actually pursue, attack and engulf living bacteria, which they proceed to kill and to digest."

Perhaps the most practical, and not the least interesting, part of this subject of natural protection from the action of the pathogenic microbes is in the fact that, in certain conditions of the body, effectual protection is not afforded. The efficiency of the phagocytes appears then to be wanting, and the germs are more likely to gain the victory—to over-run and destroy the life of the organism. This has been shown by experiments on the lower animals. Mice under the influence of chloral, for example, are the more liable to "take" infections and succumb to disease germs. Guinea-pigs and rabbits direct from the grassy fields remain healthy after inoculation with virulent germs, while those confined for a time in cages succumb. The want of respiratory expansion from exercise in the open air, with the less pure air of the cages and less natural conditions generally, while providing bacterial nutriment and stimulation, probably depress the phagocytes and neutralize the antidotal properties of the blood-serum.

We have already seen, in the explanation of the conditions of the lungs in consumption, that the protective forces of the invaded body continue to be exercised, to fight, even to the death. The defensive war is pushed on as long as the life of the invaded lasts. Apparently the defensive forces continue to do their best in the contest in various ways, and without cessation, to the end.

CHAPTER VII.

CAUSES OF CONSUMPTION CONTINUED. REMOTE OR SECONDARY CAUSES FROM HABITS AND CONDITIONS OF LIFE.

A LARGE number and variety of causes or conditions help, in a small or greater degree, to give rise to a predisposition to consumption. These appear to produce their effects mainly by a reduction of the respiratory function. They may be enumerated as follows: Impure air, from any insanitary condition, but more especially prebreathed air, from want of ventilation, or overcrowding in enclosed places; want of sunlight; improper diet, as unsuitable or excess of food; certain occupations, causing dust, stooping, etc.; overwork, mental or physical; deficient exercise, or idleness; mental depression; worry; improper clothing; intemperance in the use of spirituous liquors and, especially, of tobacco; incontinence; any habitual excess; want of good digestion and assimilation of food, leading to imperfect nutrition of the body; neglected or inactive skin, kidneys and bowels; a humid atmosphere from undrained, damp soil, or a damp house; the effects of certain diseases or diseased conditions, especially those affecting the air passages and lungs; a neglected "cold on the lungs";

exhaustive discharges; rickets, diabetes and syphilis; and, in brief, anything that depresses the bodily vigor; or diminishes the breathing: or *vice versa*. Many of these causes need only be mentioned here, while it will be well to further explain others of them. In considering the subject of prevention, they will then, too, receive further consideration.

IMPURE, PREBREATHED AIR.

Of all the secondary causes of consumption, as intimated on previous occasions, from its direct association with one of the two essential causes, a want of oxygen, from the breathing of impure, prebreathed, deoxygenated air, is the most common and important. That eminent physician, Sir James Clark, M.D., F.R.S., etc., wrote as follows (Cyclop. of Pract. Med.): "A sensible writer on scrofulous diseases considers impure air as the only real cause of scrofula; other causes may assist, but this he considers essential to the production of the disease. 'Personal experience,' says Baudelocque [whom Sir James here quotes] 'reading, reflection on a great number of facts, and the analysis of many observations, have impressed me with the deep conviction that there exists one principal cause of scrofulous diseases, a cause which predominates over all others, and without which, perhaps, the disease would never, or, at least, very rarely develop itself. This cause consists in particular conditions of the atmosphere in which the individual resides. However ill-chosen or unsubstantial his food may be, however much cleanliness may be neglected,

whatever be the nature of his clothing and its adaption to the temperature, whatever the climate in which he lives, the exercise he takes, or the duration of his sleep or waking, if the house in which he dwells be placed in a situation to which the fresh air and the sun's rays have free and direct access, and the house itself be sufficiently airy, light and well proportioned to the number of its inmates, scrofulous disease will never make its appearance. On the contrary, however well chosen or nutritious the food, however minute the attention paid to cleanliness, with whatever care the clothing be adapted to the temperature, or the duration of exercise, sleep and waking be regulated, if the houses are so placed that the sun's rays cannot reach them, or the fresh air be renewed without difficulty; if, in short, they are small, low, dark and badly aired, scrofulous disease will inevitably supervene (Memo. sur les Scrof., Rev. Med., Vol. I).' Though we are fully satisfied of the powerful influence of impure air in the production of scrofula, we cannot entirely coincide with M. Baudelocque. The disease not infrequently affects the inhabitants of elevated and dry countries, where the atmosphere is pure and the people are occupied in grazing sheep and cattle, and are hence so much in the open air during the day that the confined atmosphere of their ill-ventilated hovels can scarcely be considered the chief cause of the scrofulous diseases by which they are so often afflicted. . . . But there can be no doubt that the habitual respiration of the air of ill-ventilated and gloomy alleys in large towns, as well as that of many

manufactories, workhouses and even schools, is a powerful means of augmenting hereditary disposition to scrofula, and even of inducing it, *de novo*."

It may be observed in respect to this, that those persons engaged in the quiet occupation of grazing sheep and cattle, alluded to by Sir James Clark, take little active lung-expanding exercise, and the function of respiration is but imperfectly performed. This, together with their "ill-ventilated hovels," deprives their body of the necessary supply of oxygen, and the soil for the bacillus is eventually produced. They may breathe "a very pure air" during the day-time, yet so little of it as to produce an effect similar to that of breathing the foul air. Baudelocque further says, that a prolonged stay in a foul atmosphere is not always necessary to give rise to scrofula; but that often a few hours each day is sufficient, as in sleeping in a confined room in which the air is not frequently changed or renewed. Doctor Squire, in his late work, reports the case of a young man, seventeen years of age, in his (Doctor Squire's) hospital ward (N. London, for consumptives), who though belonging to a consumptive family, was himself "well-grown, and always strong and healthy up to the age of sixteen. He then went into service as a footman in Edinburgh, and shared with another servant a small attic bedroom, with no fire-place and only a small window which was rarely opened. After a few months in this place he developed consumption." The following, quoting my own words (Phys. and Hygiene for Schools), is well accredited: Large numbers of the

pupils at a school in Norwood, England, some years ago fell victims to consumption, and on investigation it was decided that insufficient ventilation and the consequent atmospheric impunity was the cause. Many years ago, consumption was very prevalent among the British soldiers. A sanitary commission, consisting of men of the highest standing, after investigation, declared that this was caused by overcrowding and deficient ventilation;—in other words, by rebreathing breathed air. When this cause was removed,—more space in barracks and better ventilation provided—the number of cases of this disease materially diminished.

Amongst well-to-do persons as well as the poor who often cannot well help it, there is much household overcrowding and consequent habitual breathing of foul air. In bedrooms especially, on every hand, in high-class houses, we daily witness the effects of breathing over and over again the same air. The rooms are made as air-tight as possible, and no means are provided for a change of air. Morning languor and want of vigor in persons, young and old, who otherwise would be healthy and strong, are as common as the morning awaking, and foul blood and scrofula are soon or later the individual consequences.

Domesticated animals crowded together in stables, and wild animals confined in cages, we may again note, usually die of consumption. And again, the more dense the population, the higher the death-rate from this disease.

Many other facts are upon record which prove that

the breathing of prebreathed air is a most important factor in developing a condition favorable to consumption. And it is easy to comprehend this when we consider the highly poisonous nature of, and the lack of oxygen in, air which has been once breathed.

Air polluted by various other impurities—dust, foul gases, "malaria" and dampness, when breathed, is well known to produce depressing and other marked injurious effects upon the human body; and by most persons is shunned much more than prebreathed air.

WANT OF SUNLIGHT A CAUSE.

Absence of sunlight is usually associated with impure air. Air almost anywhere deprived of sunlight for even a few days becomes impure. It is fairly well known that there cannot be good health without abundance of full sunlight, yet many persons cut it off largely from their dwellings and rooms. The marked difference between plants growing in shaded places and those freely exposed to the sun, and the paleness and frequent deformities amongst persons who dwell in dark alleys, "basements" and mines are well known. A. N. Bell, A.M., M.D., records the following (Climat. and Min. Waters of U.S. New York: Wm. Wood & Co.): Two kittens, one weighing 18 oz. and the other 18½ oz. were selected. The lighter one was placed in a well-lighted box and the heavier one in a like box but darkened. Both were fed and cared for alike in every other respect. In five days the lighter kitten weighed 22½ oz. and the other kitten only 20¾ oz. At the end of the second

five days, the former weighed 24 oz. and the latter scarcely 22. Both were then placed in the lighted box and in five days more each weighed almost 25 oz. It has been observed that there is more sickness on the more shady side of streets, and that patients progress better in the more sunny rooms of hospitals.

Besides its invigorating and purifying effects upon the entire body, sunlight is directly destructive of tubercle bacilli, as already stated: largely, probably, by its great desiccating power. It has been suggested as "an all-sufficient germicide." A want of sunlight is therefore at once both favorable to the predisposition, and to the preservation of the seed.

THE NEGLECTED "COLD": WEATHER AND CLIMATE.

A neglected or long-continued "cold on the lungs" is commonly regarded as, and is, a frequent harbinger of—an actual provider of a lodging for, consumption. It gives rise to a congested or an inflamed condition of the air chamber walls (the alveolar catarrh or alveolitis of Powell), and thus interferes much with the respiratory function; while doubtless it often, at the same time, causes a break or abrasion in the protective membranous wall, and so opens a way for the tubercle bacillus to get into the deeper structure. where, if there are favorable conditions for it, it may take root and propagate.

It should be noted here, however, and remembered, that while the so-called "cold" is in this case the less remote cause of a predisposition, we may profitably

look back and ask, what is the cause of the cold? Not, usually, in the main, is it anything beyond our control—not so much the weather, nor the climate, but far more the controllable habits and conditions of life: probably breathing an overbreathed atmosphere, often in an overheated room, with improper clothing, inattention to the protective outer wall—the skin, and perhaps overeating. In many cases I have been able to induce patients, simply by means of a habit of daily cool bathing adapted to the constitution of the individual, a cooler atmosphere in living rooms, and proper clothing and food, to entirely overcome, in a few months' time, the tendency to "take cold": a subject that will be further discussed.

Climate and weather, which give rise to conditions beyond man's control, are often blamed for causing colds and consumption when, as just intimated, the actual cause is, practically, more associated with man's self-governable habits. The powers of adaptation and accommodation possessed by mankind in general are such that, if we except marshy and malarial and damp or misty districts, hardly any condition of climate is incompatible with good health, after acclimatization, in the average, or at least with a large proportion, of the race. One's natural climate, the one in which one is born, if not of a particularly objectionable sort, is usually best adapted for health; but one can usually, with the practical application of hygienic knowledge, soon become acclimated to any country. There is not satisfactory evidence that

there is any considerable number of people, any large community, in any climate, entirely free from consumption. And, as stated by Douglas Powell in his late work already quoted from, consumption "is essentially a scourge to what we call civilization. Its rarity amongst nomadic tribes and savage populations in all climates; its prevalence in littoral districts, in river sites, and in industrial as compared with agricultural localities in townships and cities—all point to social rather than climatic influences as predominant in the cultivation of the disease." Nor can any climate be regarded as causing consumption. To be sure, in some localities, as those dry and sunny, the predisposition can be more readily overcome or prevented than in others.

THE SOIL AND DWELLING-HOUSE.

Dampness of Soil is a subject which may be more practically and profitably considered, inasmuch as the dampness may be often remedied or removed by drainage and cultivation. Many years ago, at about the same time, the late Doctor (Sir George) Buchanan, in Great Britain, and Doctor Bowditch, in Massachusetts, proved by statistical facts that consumption is more prevalent amongst a population living on heavy, impermeable, and hence damp soils, as in low-lying or high, undrained areas, than on a lighter, more porous soil susceptible to natural drainage. There is evidence indicating that a barren, sandy soil is inimical to the life of the tubercle bacillus. Middleton has shown that the more impure condition of the damp

air, usually, is a causative factor. Atmospheric moisture, when not too cold, doubtless favors bacterial growth and probably the preservation of virulency in the tubercle bacillus; while usually bronchial disturbances are more common in the damper, colder localities, especially in persons not well acclimated or not vigorous. In this way the relationship between damp soils and consumption may be largely explained. Moreover, the skin is less active, and probably the respiratory function is less complete, as in respect to the exhalation of poisonous moisture from the lungs, for example, in a damp atmosphere. The diminished prevalence of the disease after drainage of the soil has been also conclusively shown.

The Dwelling-house as practically an important factor in the development of consumption is worthy of notice. In both locality and construction it may become a remote predisposing cause; and infected, too, and so favor the spread of the disease. Doctor Thorne Thorne (St. Barthol. Hosp. Rep.) sums up the "conditions of the dwelling-house tending to the promotion of tubercular consumption," as follows: 1. A soil either (*a*) naturally damp and cold; or (*b*) subject to the influence of the rise and fall of a subsoil water lying within a few feet of the surface. 2. A dwelling-house of which either the foundations, the area they enclose, or the walls are, by reason of faulty construction or otherwise, liable to dampness. 3. Such immediate surroundings of the dwelling-house as tend to prevent the free movement of air about it and its ample exposure to the influence of

sunlight. 4. Such structural defects as would prevent the maintenance within all parts of the dwelling-house of ample movement of air by day and by night, and free exposure of its habitual rooms to daylight." Besides the depressing influence of living under circumstances favoring dampness, lack of ventilation and want of exposure to air and sun, such residence is followed, Doctor Thorne adds, by "bodily lassitude, which in turn often brings about loss of functional activity in certain portions of the lungs—a state which is most grave when battle has to be done with an extraneous living organism, seeking to obtain and maintain a habitat therein." The dust in dwelling-houses, as well as in shops, offices, etc., is often a source of lung irritation. Dust is made up of particles of almost all sorts of substances, organic and inorganic, and is inconceivably complex in its composition :—of particles from insects and domestic animals, as well as from the human body, and may, and indeed not infrequently does, contain infections. Much care should be exercised in keeping dwellings as free from dust as possible. Further on, evidence will be given showing that houses may become infected, and then retain the infection and communicate it to other persons. The following case (Brit. Med. Jour., April 8th, '93) may be given here as particularly instructive: "A family of nine persons moved into a house in Paris inhabited ten years before by two consumptives. A short time after, although the whole family had always previously been in excellent health, three among them showed symptoms of tuberculosis.

They used the same bedroom as the former consumptives. Doctor Ducor had pieces of the wall paper and dust from the ceiling and walls examined, and in both tubercle bacilli were found."

Workshops, factories, and other enwalled places, as well as dwellings, may obviously, in like manner, become causative factors of this disease.

THE DIETARY: COOKERY.

An improper diet has always held a high place in the list of predisposing causes of consumption. In respect to it, here, and to bad cookery, I prefer to again quote Sir James Clark, and also Sir B. W. Richardson. Among the causes of consumption, Sir James Clark writes, an "Imperfect supply of food holds a conspicuous place. But we have rarely an opportunity of seeing the effects of this alone," he adds, "because when the means of procuring proper nourishment are wanting, there are generally other causes of the disease in action at the same time; such as residence in ill-ventilated and dark apartments, exposure to cold from imperfect clothing, etc., the whole of which are often combined, and hence more speedily effect the deterioration of the health. Food in excess, or of a kind too exciting for the digestive organs, may also induce tubercular cachexia, a circumstance which is not sufficiently attended to—we may say not generally understood—even by medical men; nevertheless, we hold this to be a frequent cause of scrofula, and believe that it produces the same effects on the system as a deficient supply; the

imperfect digestion and assimilation in the one case and the inadequate nourishment in the other being equally injurious; the form and general characters which the disease assumes may differ, but the ultimate result will be the same in both cases. The adaptation of food, both in quality and quantity, to the age of the individual, as well as to the powers of the digestive organs, is too little considered; and the evil consequences of this neglect are often evident in the children of the wealthy classes of society, who are frequently allowed an unrestricted use of the most exciting kinds of animal food."

Bad dietary and bad cookery, Sir B. W. Richardson remarks (Preventive Med.), "are active causes of disease in, perhaps, all classes of the community, but especially amongst the poorer class. . . . In cases where the food is fairly good in quality as it first comes to hand, it is so destroyed by the various processes of cooking and preparation that half the proportions of it, as digestible, wholesome and sustaining nourishment, are sacrificed. . . . The digestive system is first injuriously influenced by errors in dietary: but many other of the vital systems, including specially the circulatory, the nervous, the glandular, the muscular and the membranous, are injured by these errors in respect to the supply of food for the sustenance of the body." Hence, in such circumstances the body is often not sufficiently nourished, and general debility follows, with, most likely, lassitude and imperfect breathing.

OCCUPATION, TOBACCO, ETC.

Certain dusty and other occupations favor a predisposition to consumption. Those which tend in any way or degree to interfere with a full respiratory function,—such as give rise to more than the usual amount of dust in the atmosphere breathed, or in which certain body positions, more or less necessary, cramp the chest or limit the full and free expansion of the lungs, are especially so. Dust is more lung irritating than it is commonly supposed to be. In a large number of manufacturing industries, as of pottery, cutlery, flour, woollen goods and many others, the dust produces an irritating effect upon the delicate lung membrane, which, when continued, interferes greatly with the respiratory function. Those occupations, too, in which it is necessary to work where there is not abundance of sunlight, as in dark rooms and mines; and in which the temperature of the air is kept too high, or above about 60° or 65° F.; also, except in the most vigorous constitutioned persons, such as cause exposure to inclement weather, or to sudden changes in it, to irregular habits, broken sleep, confinement indoors, etc., favor the predisposition; and, therefore, should be avoided by all who are not of full vigorous constitution.

The use of tobacco, as a remote cause of consumption, is deserving of special notice before concluding this part of the subject. It is in no way or degree an essential of life or health to anyone, nor is it ever contended that it is, but, on the contrary, is an un-

natural, acquired habit, adopted, it appears, in imitation of an uncivilized people. Whatever may be the soothing effects or germicidal properties of this most powerfully noxious, depressing weed, and however many persons may live to advanced age in spite of its long use, it cannot fail, however moderately used, to depress, in a proportionate measure, the vital functions and powers. Then, in support of such a natural theoretical conclusion, we have the recent experiments of Professor Harley in testing the influence of tobacco smoking on muscular work, and his declaration, based thereon, that it "highly diminishes muscular power and hastens the onset of fatigue." Since the above (of this paragraph) was written, strong evidence of the irritating effects of tobacco in causing tubercle of the tonsils has been published (M. Tussau, Lyon Med.).

Of the other remote causes of this disease, above enumerated, it is not difficult for anyone to understand that they indirectly depress, in a certain measure, the vital powers of the body and so debilitate the system; it may be in a measure entirely inappreciable for a time, or unknown to, or unrecognized by, the individual, yet still they debilitate and depress. Amongst the poor, for example, in their struggles for existence, and sometimes amongst the well-to-do in their struggles for wealth, excessive labor prostrates the vital powers. So, with idleness or inactivity, like effects are produced, like results follow. There is then with such depression, besides other functional defects, almost always a tendency to stoop, with consequent lung compression and diminished respiration.

CHAPTER VIII.

CAUSES OF CONSUMPTION CONTINUED. THE INFECTIOUSNESS AND COMMUNICABILITY OF THE DISEASE.

GENERAL REMARKS ON INFECTION.

SOME physicians of the highest standing and much experience still question the infectiousness or contagiousness of consumption. It would appear as if this, in a measure, may arise from the very indefinite, unsettled general application to diseases of these two terms, infection and contagion.

What an infectious disease is, precisely, or where the dividing or distinguishing line is between one that is infectious and one that is not, has never been, in practice, clearly or satisfactorily explained. Still more unsatisfactory has been the use of the term contagion. The two terms, too, are commonly used almost or quite synonymously; while their practical application varies somewhat in different countries. It would be well if some authoritative organization would fix upon a form of application of them which could be brought into general use in medicine. The wide difference between the derivation of the words —one, infection, from a word signifying, in the original, to dye, stain or corrupt; and the other, to touch

(contaction, touching)—together with the facts that some so-called infectious diseases are of a much more infectious nature than others—more liable to be communicated from the sick to the healthy—and that some diseases regarded as both infectious and contagious may arise by means other than direct communication from infected to non-infected persons, make the subject a complex one. The term communicable has therefore come into more general use in this connection during recent years. Without entering into a lengthy discussion of the general subject of infection, a few remarks here on some points of it may be of practical use.

All infectious diseases have as an associated and essential factor a specific germ, in each disease of a kind peculiar to itself. Almost all of them, too, possibly the so-called malarial diseases, are communicable from a person affected to one not affected; they are "taking," and by means of the specific germs, in one way or another. Some, as hydrophobia and scabies, are taken only by actual contact; others, on near approach to them—atmospheric; and yet others, apparently only by means of some solid vehicle, as food, clothing, etc., or of water.

As to the infectiousness, contagiousness and communicability of small-pox, scarlet fever and measles, for example, there is no question. Nearly everybody not protected by a previous attack, on close exposure to these diseases, becomes infected and takes them. The exact nature of their respective specific infections or germs is not yet known; but it appears evident that

the germs are given off, and very abundantly, from the surface of the body through the skin, while they are probably much more minute than those of the less infectious diseases, and so the easier get within the body. If we could see them, we should perhaps observe myriads of them in the air around about and near to a case of either disease—somewhat, perhaps, as we see the myriads of spore-carrying particles fly off from the puff-ball fungus when it is touched, with which everybody is familiar. Then these germs, like many ill weeds, take root and grow in almost any soil: almost everybody provides, at one time or another, a suitable soil. These are clear, well-known types of infectious, or contagious, communicable diseases.

On the other hand, good authorities long questioned, and it appears that a few still question, the infectiousness or communicability of typhoid (or enteric) fever. Especially is this the case in regard to its communicability by means of the medium of air, as distinct from that of water or milk. It is with this disease as it is with consumption: comparatively few persons who are simply exposed to it, take it in the ordinary way, or as in the case of scarlet fever, etc. Both diseases hold a place intermediate between the more characteristic infectious diseases and malarial diseases. In both, the germs are contained, for the most part if not entirely, in the excreta from the bowels and lungs, respectively: and although given off abundantly in this way, probably not in numbers nearly approximating the numbers given off from the skin in the other diseases above named,—just as some plants in ordinary vegeta-

tion yield many more seeds than do other plants. They are, too, in a condition in which they cannot nearly so readily fly about in the atmosphere around the persons infected. Again, they are apparently more tender seeds and will only grow in special soils—"rich" soils, it may be supposed, as already intimated; as a rule, probably only in foul conditions of the intestines and lungs, respectively. As stated on a previous page, too, it may be here noted, some high authorities believe, and on good evidence, that typhoid fever does not always arise by infection, as we commonly understand this term, but that it sometimes arises anew, *de novo,* from germs which had lost their virulency by exposure to air, light, etc., and which are made again virulent by insanitary conditions; or, as some believe, from the transformation of the benign bacillus coli communis into the virulent bacillus typhosus. Similar, it appears to be, with consumption. Again, in respect to diphtheria: we have already observed Trouessart's belief, that a child contracting a simple (inflamed) sore throat, the product, or discharge, from which excites into virulent action diphtheritic micrococci, which up to this time had remained inert in the mouth, and a form of diphtheria is produced (the micrococci being possibly the early form, and the bacilli the adult form, of one species of micro-organism). Physicians generally, it appears, believe that this disease may not infrequently arise in this way, or by means of inert or dormant germs from some source other than a present case of the disease—practically *de novo.* Hence, they habitually recommend parents to exercise watchfulness and

care in cases of simple sore throat in their children. We would not say that cases arising in this way had been caused by, or had arisen by means of, infection from another person. Some outbreaks of typhus fever can only be explained in a somewhat similar manner. Good authorities look upon intensity of population or overcrowding in a dwelling, or a collection of dwellings, as practically the exciting cause of this disease. The essential germ or seed is always a factor in the causation or origin, and previous to the outbreak it had been growing or lurking somewhere in a non-virulent state until excited or intoxicated into pathogenic action by the foul products of the overcrowding. Consumption, too, as already noted, we must bear in mind, is analogous to typhus in this respect, and becomes the more prevalent in proportion to increase or density of population in a given or limited space, even to tenfold, it is recorded; as, for example, in a city's slums.

Regarding the infectiousness of consumption, Doctor R. Douglas Powell, who does not believe the disease is infectious "in the ordinary circumstances of life," writes as follows (Ætiol. of Phth.: Dis. of the Lungs): "We can practically say, with many of the zymotic diseases, *e.g.*, enteric fever, cholera, scarlet fever, that we have health on the one hand and a specific organism on the other, and that this latter invades and destroys the first. We can rarely, if ever, say this of tubercle." Now, it is quite possible that this apparently wide difference between "tubercle"– consumption, and the other diseases named by Doctor Powell is in a large

measure in the degree—the perfectness or otherwise, of what he terms the "health" of the exposed person.

According to Doctor Alfred Carpenter, as we have already observed, a person in perfect health—that is, with all the various organs in full harmonious action, and hence the body fluids and tissues free from any excess of used-up, effete or excrete waste matter—will not take, or will not manifest symptoms of, any infectious disease—will not harbor the infection long enough. Such person provides no soil for what Doctor Carpenter evidently regards as saprophytic micro-organisms. It is possible to imagine, perhaps hardly to attain, such a degree of personal health as would resist all disease germs. A short step was made, however, in this direction a century or two ago (even thousands of years ago, it appears, by Eastern peoples) when direct inoculation with small-pox virus was practised on persons previously prepared for it by a course of hygienic treatment. As already intimated, with a sufficiently complete system and course of hygienic preparation of the individual to be inoculated, possibly the small-pox infection, instead of being only modified or simplified in its action after such inoculation, might, if not from highly virulent sources, entirely fail to grow in the purified body from want of natural nutriment, or be resisted altogether by the natural forces of the thus prepared individual. So it is possible that it is only apparent and not absolute health "on the one hand," as Doctor Powell words it, "which the organism invades and destroys." In other words, a much greater falling-off from the health standard of

the individual host seems to be necessary for the action of the tubercle bacillus than for the infectious germs of other diseases.

There are probably very few persons so healthy and vigorous as not to succumb to the effects of inhaling enormous numbers of active virulent tubercle bacilli; as in certain experiments by Tappiener with dogs in a room the air of which was charged with the bacilli; to be noticed further on. The germs would reach the lungs in such numbers that possibly the phagocyte cells and blood-serum antidote could not successfully resist them (Orth). Or, what may be still more likely, germs may sometimes—in certain conditions and circumstances of environment, as in certain foul-conditioned human bodies, in a highly "scrofulous" person in the case of tubercle bacilli—become so virulent, so irritating, so poisonous, that, when at once conveyed into the body of another and fairly healthy person, or any person, they quickly poison and destroy the life of such an amount of invaded tissue elements or substance as to provide themselves—their phagocytic, perhaps now pathogenic, appetite—with dead matter, and so possibly, if not most vigorously opposed, be enabled to go on with their destructive work.

It can only be said, then, that the infectiousness of a disease, or the degree of it, or the frequency of its communicability to others, is largely a question of (*a*) the number of active specific germs given off from the body of the infected person, (*b*) the degree of virulency, or of poisonous character, of these germs

—as from their source,—and (*c*) the body condition, or soil, presented for the root-taking or growth of the germs by the non-infected exposed persons.

HISTORY OF THE INFECTION THEORY.

From the period of the earliest records in the history of medicine, it appears that the infectious nature of consumption—the possibility of it being communicated from the consumptive to others—has been believed in by physicians of the highest repute. Over two thousand years ago (400 B.C.), in the time of Father Hippocrates, physicians believed in it. Aristotle (330 B.C.) wrote that the Greeks in his day believed in it: and he asks why consumption, sore eyes and itch are common to persons who associate with others suffering from these affections. Later (A.D. 180), Galen wrote that it is dangerous to pass the whole day with a consumptive person. Coming down to much more recent periods, Morton, over two hundred years ago, wrote of consumption that "a contagious principle often propagates this disease, for, as I have often found by experience, an affected person may poison a bed-fellow by a kind of miasma like that of a malignant fever." Riverius, about the same time, believed contagion to be the "chiefest" cause of consumption. "We may observe women to be affected by their husbands," he wrote, "and men by their wives, and all the children to die of the same, not only from infection of their parents' seed, but from the company of him that was first infected." The eminent Italian, Valsalva, in the early part of

last century, was himself predisposed to consumption, and avoided being present at dissections of the lungs of persons who had died of the disease. Valsalva's illustrious pupil, Morgagni, declared that he made but few post-mortem examinations of persons who had died of this disease for fear of contracting it. A law once existed in Italy by which the proprietor of a house in which a consumptive had died could claim payment for his furniture, which was burnt; and it was difficult for a consumptive to obtain lodgings.

Over a century ago, a reaction commenced to show itself. Eventually, in northern Europe and America especially, doubt respecting the infection theory developed into general disbelief. In the warmer latitudes, however, this was not the case, and at length there was a change again in the more northern countries; and with the results of the investigations of the last few decades, disbelief and doubt have for the most part disappeared. In 1865, Villemin inserted minute particles of tubercular matter from man and from the cow under the skin of rabbits, and after about fifteen days found tubercles in the lungs and other parts of these animals. In 1867, Doctor Wm. Budd (Lancet, Oct. 12,) took strong ground in favor of the infection theory. He concluded that tuberculosis is a true zymotic disease of specific nature, in the same sense as typhoid, typhus, and scarlet fevers. The evidences of this he finds in,—(*a*) Considerations based on the pathology, consisting in the evolution and multiplication in the organism of a specific, morbid matter. (*b*) Actual instances in which there is

evidence to show communication from one to another (*c*) The geographical distribution of phthisis, and especially its fatality in countries which were entirely free from it when first discovered by Europeans. (*d*) Its greater prevalence in low levels and crowded communities, and entire absence, except by importation, at high levels. (*e*) Its high rate of prevalence in convents, barracks, penitentiaries, etc.

HISTORICAL EVIDENCE OF INFECTION.

When the South Sea Islands were first discovered, Doctor Budd says, there was no consumption amongst them; but since they have come in contact with Europeans, the disease has become so wide-spread as to threaten their extermination. The late Doctor Rush, of Philadelphia, who made accurate inquiries, satisfied himself that there was no consumption amongst the American Indians when America was discovered. Now it is very common and fatal amongst them. In Africa, everywhere along the seaboard, says Doctor Clapp, where the blacks have come into intimate relations with the whites, there has been a large mortality from the disease, but in the interior, where there has been contact with only a few travellers, it has not been found. Of this fact, Doctor Livingstone and other African travellers, it is said, have given Doctor Budd positive assurance.

It must be remembered, however, that certain obvious habits of civilized life, introduced amongst the natives of these countries, have doubtless contributed largely to the development and spread of the disease,

aside from the infectious germs, and hence caused it to appear more actively infectious than it really is.

In a pamphlet (Contag. of Phthis., 1888) by Lawrence F. Flick, M.D., of Philadelphia, Pa., the author says, "Those portions of our country which were settled by the Spaniards, namely, California, Arizona, New Mexico, Texas, Florida and Colorado, were almost absolutely free from consumption until they became the Sanataria of consumptives from the north and north-east. Intelligent natives of these countries will tell you that, prior to the mingling of the English-speaking people amongst them, the disease did not occur in their country. In fact, it was the generally acknowledged freedom of these places from the disease that gave them their reputation as resorts for the phthisical. . . . The whole Pacific coast, as well as Florida and Colorado, is acquiring a doubtful reputation for consumption. A look at the map of the United States Census Report for 1880, in which the topography of phthisis throughout the United States is indicated, will be apt to shake the confidence of the searcher after a climate for the cure of consumption, so far as these countries are concerned, at least. The islands of Bermuda and Madeira probably underwent the same experience. Both, at one time, enjoyed the reputation of being ideal climates for consumptives. They have both lost that reputation because the disease became too prevalent there. The history of Madeira is especially interesting. The natives of that island so feared consumption that 'no pecuniary consideration whatever would

induce them to accommodate phthisical patients, wrote Doctor John Gordon, in 1784. And well they might fear it, for, after years of introduction by the English, the disease became endemic in the island. Doctor William Gourlay wrote, in 1811, 'that the disease of phthisis pulmonalis was an endemic in the island, and that its fatality was prodigious among the inhabitants.' There is reason to believe that the Jewish people were free from the disease whilst they dwelt in the Promised Land. The disease is referred to in the Old Testament as a disease of Egypt, and is spoken of as a visitation or plague."

STATISTICAL EVIDENCE OF INFECTION.

In Germany the sick in the hospitals are largely attended by members of religious sisterhoods, and these sisters are consequently much exposed to the infection of consumption. "Taking thirty-eight of these nursing corporations, Cornet found that, during the last twenty-five years, of their total mortality, 62.8 per cent., or almost two-thirds, was recorded as being from tuberculosis: while of those members of the corporations dying between the ages of twenty-five and thirty-five, no less than 73 per cent. had succumbed to this disease."

In his translation of Ziemssen's work on Tuberculosis, already quoted from, Doctor Doherty gives, in an Appendix, reports for the years 1887-88, from thirteen prisons in the United States in which the average mortality from consumption had been over 50 per cent. of the total mortality; more than half

the deaths of the prisoners being from this disease. In the Clinton Prison, N.Y., the mortality was 66 per cent.; in that of Joliette, Ill., and the Eastern, of Pennsylvania, over 77 per cent.

Evidence of the infectiousness of consumption was brought out a few years ago by Doctor Flick, above cited. He localized all the deaths occurring from the disease in one of the wards of that city for a preceding period of twenty-five years, and showed that nearly one-third of the houses in that ward had been infected by previous cases of the disease. In many of these houses the deaths from it had been numerous, and of the total number of them in the ward during the year 1888, more than one-half occurred in the infected houses although there were more than twice as many non-infected as infected houses in the ward. The infected houses, it should be noted, were, doubtless, in other insanitary conditions, probably damp and not well lighted.

In 1883, a committee was appointed by the British Medical Association to make collective investigations respecting the infectiousness of consumption. The committee sent out circulars to members of the profession in England asking for reports of facts bearing upon the subject. Over one thousand answers were received, in about three-fourths of which the evidence was negative, while about one-fourth related to special cases in which the disease was believed to have been communicated by infection, the majority of them between husband and wife.

HISTORY OF INDIVIDUAL INSTANCES AND CASES.

Instances of the importation of consumption into villages in France previously free from it have been collected by Doctor Allison (Arch. de Med., Sept., 1885). Respecting these I take the liberty to quote Doctor Squire's remarks: "Individual members of healthy families, living in villages where consumption is quite unknown at the time under observation, visit other localities and stay with phthisical persons. They become themselves consumptive, and on their return home other persons in the village, who are on terms of intimacy, or who live quite close to them, also become affected. In other cases a phthisical patient from elsewhere comes to live with healthy persons in a village previously free from phthisis, and those with whom he lives become consumptive. Allison concluded from his observations that phthisis, introduced into previously healthy districts by an affected person, spreads to those in close contact with the individual, and having attacked the susceptible, disappears in that locality until reimported."

The following case, from this series of observations, is given by Doctor Squire as an example: "A man aged forty-five years, living in a village in which no deaths from phthisis had occurred during the previous ten years, was accustomed every year to visit, for a week, his brother-in-law who lived at another village 150 kilometers from his own home, and who had consumption (pulmonary tuberculosis). In 1880, the subject of this observation had pleurisy, and on

his return from his visit next year to his brother-in-law, with whom he slept, he himself became affected with phthisis, and died in 1884. He infected two other persons in his native village" who lived near him (Hyg. Prev. of Consump. Lond.: C. Griffin & Co.).

An instance was reported a few years ago (Brit. Med. Jour.) of an apparently infected office in Paris in which thirteen of the clerks had died of consumption in four years. Infection was attributed to the practice which prevailed in the office of spitting on the floor. A most remarkable instance of house infection is given by Engelmann, who relates the history of a dwelling which for eight years after its erection remained free from tuberculosis. Then two of the inmates died of that disease after some months' illness. From that time onward for the period of twelve years the dwelling was inhabited by a number of different families in succession, and was scarcely at any time free from consumptive patients. Thirteen fatal cases occurred in the twelve years. A startling account of an epidemic of tuberculosis was given at the Paris Congress of 1890. Of thirty-five workmen in a certain factory, twenty-seven suffered from tuberculosis; four had the disease previous to admission, and twenty-three became affected in the factory. The period of incubation was two months (Prof. J. E. Graham, M.D., add. Can. Med. Assoc. meet., '92).

Many individual instances of cases are upon record in which it appears altogether probable, indeed seems hardly open to doubt, that the disease was communicated by infection. Want of space prevents the

details of many of these being given herein, but the brief history of a few cases, as an example, will be instructive. The following synopsis is from a notable collection of similar cases by Herbert C. Clapp, A.M., M.D., of Boston (Is Consump. Contag.? Boston: Otis Clapp & Son, 1881): "Twenty-five cases" are described which, as the author says, "make mention of sixty-six persons who became consumptive probably through contagion." They were collected from different authorities, the names of which are given in Doctor Clapp's book.

At Haynin, in Belgium, a woman died of tubercular consumption of the third stage, having slept with her husband to the last. The latter, of an originally sound constitution, and belonging to a family in which consumption had never been known, took for a second wife a woman of an equally strong constitution and of healthy parents. After eighteen months of wedlock he yielded to pulmonary consumption. The second wife continued to sleep with him until his death. A short time after this she married again, and two years after the second marriage, died of consumption. Her second husband, perfectly robust, and belonging to a family which had never known an instance of consumption in it, yielded to this affection sometime after the death of his wife.

J. had seen his mother, two brothers and a sister die of pulmonary consumption, and had himself, on two occasions, hæmorrhages from the lungs when twenty and twenty-one years old. He became a sailor, married at the age of twenty-seven, and had

in all four wives: First, a woman belonging to a perfectly healthy family, who enjoyed excellent health until her third pregnancy, when she began to cough and grow thin. She died of consumption after her third confinement. The second wife had every appearance of health, but at the end of a year began to cough and spit blood, and soon died of "quick consumption." The third wife belonged to an exceptionally healthy family, consisting of a father, mother, four brothers and two sisters, all living and in good health. Seven weeks after her second confinement she showed extensive disease in the upper part of the lungs and died shortly after of tubercular consumption. The fourth wife, twenty-three years old, had not a sign of consumption in her family, and was in the enjoyment of perfect health. Thirteen months later—three months after her first confinement—she began to cough, and died nine months after. The autopsy showed tubercular lesions in both lungs, intestines, spleen and liver.

The history of J. is instructive. At two different times—in 1854 and 1857—during the illness of his fourth wife, Doctor Herman Webber, who reported the cases, had occasion to examine him. His general health he (J.) said was excellent. He did not cough, but expectorated in the mornings (upper part of left thorax flattened, and less resonant). He continued to do *active duty as a sailor* until 1869, when he was forced to keep his bed for some months on account of a severe fracture; he then began to cough, consumption developed, and caused his death in 1871.

Mr. H., of a consumptive lineage, married a Miss R., of a remarkably healthy family, noted for longevity. H. continued to gradually grow worse, and died at the expiration of eighteen months. His wife was his constant companion and nurse, and some three months before his death the premonitary symptoms of pythisis manifested themselves in her, and some twelve months after his death she died. One child was born of the marriage, which lived about one year, and died of tubercular meningitis. Mrs. H. was closely nursed by a single sister, who, some time prior to the death of Mrs. H. gave unmistakable evidence of commencing tuberculosis, and died some twelve months after. The single sister was nursed by a younger brother, and he only survived his last sister's death a few months, dying of the same disease. The remainder of Mrs. H.'s family lived at a distance, were seldom at her house during the sickness of any of those above recorded, and not one of them has ever had any disease of this class. The father and mother were living and in good health, aged between eighty and ninety years.

EXPERIMENTAL EVIDENCE OF INFECTION.

Tappeiner dried and pulverized expectorated matter from the lungs of consumptive persons and sprayed the powder in the atmosphere of a room in which dogs were confined. Dogs are not very susceptible to tuberculosis, yet in this way they contracted the disease. Bertheau made like experiments with like results. It is stated that when Tappeiner was per-

forming his experiments, a robust servant, aged forty, laughed at the idea that consumption could be communicated in that way, and in spite of all warning went into the inhaling room, breathed the infection and died in fourteen weeks of consumption.

Giboux put rabbits in a close cage, and introduced into the cage air expired by (*i.e.*, the breath of) consumptive persons. In three months the rabbits showed marked symptoms of tuberculosis, and tubercles were found in many parts of the body—mostly the lungs. Another cage of rabbits he supplied with the same sort of an atmosphere, except that he first filtered the breathed air through tow charged with carbolic acid. No signs of tuberculosis in these animals followed.

The well-known spread of tuberculosis amongst the lower animals—in herds of cows and flocks of poultry—and the evidence to be given in another chapter respecting the probable intercommunicability of the disease between mankind and the lower animals, afford additional testimony of the infectious nature of this disease.

CIRCUMSTANCES MODIFYING THE ABOVE EVIDENCE.

There are modifying circumstances bearing upon much of the above-mentioned evidence of infection in this disease which it is desirable to notice and bear in mind: this especially as relating to the degree of infectivity or comparative frequency of spread in this way. For example, in reference to the inmates of convents: the bacillus could not infect, were not

the body condition of the inmates specially favorable. As Ziemssen words it, "the privation of fresh air and the complete lack of bodily exercises which compel deep inspirations are the chief causes of the disease;" —they are indeed the more important, the exciting, and the more preventable causes. There are, too, many other depressing, and hence causative, circumstances in connection with the sedentary life of such persons, so obvious that they need not be mentioned, which help to swell the phthisis mortality amongst them. Amongst pupils in the large schools and the inmates of orphanages, the mortality is higher than the average of that of the general population, but not so high as that of persons in convents and prisons. Why? Because, chiefly, the confinement in the former cases is not so close, and the younger people do not remain so long in such places, as in the latter. It is especially noteworthy, too, that the mortality amongst the inmates of convents and prisons is proportionately greatest, as would naturally be expected, in those who have been longest in confinement.

Again, criminals, as a rule, both from constitutional structure and habits of life, are the more likely to have a predisposition to consumption.

Persons nursing others suffering from this disease, as a wife a husband, are exposed to other causes of it as well as to the infection:—the stooping, lung-confining position often required, the confinement, want of rest and often of sleep. The close devotion, too, of a wife or a sister to the nursing of one near and dear, makes the position a much more trying and exposed one than in the case of an ordinary nurse.

Finally, respecting Giboux's experiments: Had Giboux caused the rabbits to breathe only the already breathed air from persons *not* consumptive, the result might have been the same. The toxic effects on the animals of the usual poisons in expired air might have caused the disease in the rabbits, if in any other way tubercle bacilli, possibly dormant non-virulent ones, could have gained access into the lungs of the animals, rendered strongly predisposed—with tissues providing the exciting cause—from inhaling simply the foul prebreathed air.

EVIDENCE OPPOSED TO THE INFECTION THEORY.

Positive evidence against the theory that consumption is sometimes communicated by infection is in the very nature of things difficult or impossible to obtain. Evidence against it must ever be, therefore, rather of a neutral character.

The evidence which is most commonly given in opposition to the theory is that of statistics of the Brompton Hospital for Consumptives, in London. These extend over a period of more than a third of a century, and certainly give no evidence of infection. Among the twenty-nine resident physicians and assistant physicians of the institution during that period, there was but one case of consumption, and the subject of it was tuberculous before entering the hospital. Of one hundred and fifty clinical assistants, eight died of consumption, but only one of these eight was free from the disease at the commencement of the clinical duty. Of one hundred and one nurses,

only one was consumptive. The variously appointed servants were alike exempt from the disease. More recent statistics from the Friedrichshain Hospital, Berlin, give a like record.

It is very well known that physicians and their assistants, and even nurses, but rarely take any infectious disease when attending cases of it, even scarlet fever and diphtheria. They are usually in such a body condition as not to provide a soil for the germs. Less frequently do they take typhoid fever and Asiatic cholera. A few well-authenticated cases in which, for example, a healthy, vigorous woman with a family history free from predisposition to the disease becomes consumptive a few months after attendance on a consumptive husband, and dies from the same cause, tell more in favor of infection as a cause than any collection of statistics can against it. Moreover, the fact that many wives nurse consumptive husbands and do not become consumptive thereafter does not tell very much against the infection theory. We explain this by supposing that such wives so live as not to give rise to a strong enough predisposition, and that the infection—the bacillus—in these cases may be less virulent; as it is well known that some bacilli are much more virulent than others, and will "take root" and act as disease germs in circumstances in which other bacilli will not.

Austin Flint, in relation to 670 cases of his own collecting, bearing upon the communicability of the disease between husband and wife, says, "In my collection of cases . . . five are all that I find in

which there is room for suspicion" of the disease having been so communicated. And "it must, therefore, be concluded that the analysis of my cases does not furnish facts sufficient to render the communicability of phthisis probable." This simply means that it may be infectious, but Doctor Flint's cases furnish no positive evidence of it. Mays (before cited) does not give any statistics of his own but quotes those of others, and gives other evidence which in his opinion bear against the infection theory, in which he himself does not believe.

Sir Benjamin Ward Richardson, M.D., LL.D., F.R.S., editor of the Asclepiad, London, in that classic health periodical of April, '94, states that, although he had determined in the early part of his professional career, about half a century ago, to "watch intently, without bias, and persistently," for evidence of infection in phthisis, and in all his experience, thousands of cases of the disease having come before him (for the most part dispensary patients), he had not found "a single particle of evidence" that "sustained the contagion theory," or, strange to relate, "gave on reliable data the least color to it." Sir Benjamin continues: "Phthisis pulmonalis will disappear just as broad sanitary views are established and brought into practice. . . . Under the new conditions, with provision for a better heredity, in which cleanliness becomes the watchward, in which youths enjoy free exercise in the open air, and labor in confined places is reduced to a proper standard, the disease would die out altogether. . . . It is quite practical to take care

that the expectorated secretion of consumptives is destroyed. . . . But this is merely a matter of cleanliness, . . . of perfect hygiene."

A DEGREE OF INFECTIOUSNESS FAIRLY ESTABLISHED.

With all the weight of circumstantial evidence—historical, statistical, and clinical or individual—which we have in favor of the infectious nature or occasional communicability of consumption, together with the fact that the tubercle bacillus, which seems clearly to be, and is almost universally recognized as, an essential specific cause of the disease and as being present in all cases of it; that inoculations of pure cultures of this bacillus or of tubercular matter will produce the disease in animals; and that the disease has been frequently produced in human beings by the accidental inoculation of such matter in various ways, as in post-mortem investigations, injury from broken spittoons, etc. (Heron: Evidence of Com. of Phth.), it seems difficult to understand how anyone can doubt that the disease is in a measure infectious—that it may be, and sometimes is, communicated by infection, as commonly understood by this term,—by active, virulent germs being conveyed directly from an infected to a non-infected but susceptible person. To admit that the bacillus is an essential cause of the disease, and that the disease may be caused by inoculation of it into the body of a susceptible person, is surely equivalent to admitting that the disease is communicable in certain circumstances, and therefore practically infectious.

What is the difference, let us here inquire, between infection and inoculation? In the latter process the virus, or infection, is conveyed to the unaffected person (usually) purposely by a special instrument, and by it is pushed through the cuticle into the fluids (blood or lymph) of the true skin; in the former, the infection is conveyed in an accidental manner by air, food, etc., to the mucous membrane lining the inner cavities, and, as it were, finds its own way, or is pushed by some means, probably, through a break in the soft epithelium, or inner cuticle, into the fluids of this membrane. In the case of the more infectious diseases, the infecting particles are probably the more infinitely small, and hence the more easily get through a break in the wall, or through a minuter one, and so the more surely and frequently infect.

Doctor Herman Weber has said, now some years ago (1885, Croonian Lectures, Lon., Sect. 1), "We know that it [the tubercle bacillus] thrives in the bodies of most warm-blooded animals when inoculated; but this does not prove that it will find a nidus [nest or soil] in healthy tissue when merely brought into contact with it by surrounding air." Certainly it does not. But as already has been intimated, this term "healthy"—whole, clean—practically defines the difference between persons who "take" the disease—become directly infected by it—and persons who do not; and a want of health, or wholeness, the difference between infection and inoculation. With a break in the wall and unclean tissues, one becomes inoculated and infected.

We may ask how many strictly healthy persons in this sense are there—with absolutely clean, pure tissues and fluids, whole and sound, with all the various bodily organs working in complete harmony, who do not provide intoxicating nutriment for the micro-organisms, or are able to resist their virulent action? How many persons among the masses of the people are absolutely "healthy" on such a standard? Very few. Yet is it an unreasonable, impractical standard? It is not an impossible one. Hence it is one that may be fairly aimed at for both individuals and communities. On the whole, doubtless, a good many persons are in the enjoyment of such a condition. Why should not many more, or all, enjoy it eventually? True, it is a standard not attainable and retainable without care and effort. But it is really worth more than the care and effort which would be usually required.

In the present condition of the masses, with the much unhygienic housing, clothing and dieting, and with the consequent prevalence of catarrhal conditions, "colds," etc., a large proportion of the people doubtless present in the walls of their minutest bronchial tubes. defects or breaks—"mucous abrasions, upon which the bacillus can settle," using Doctor Weber's words, when further on he points out how catarrhs may open a way for virtual inoculation with the bacillus. At the same time, from these and other unhygienic conditions, the tissues and fluids of many of these people contain such an excess of dead matter as to provide all the conditions—the suitable soil, as already explained—for the most rapacious, sapropyhtic bacteria,

and probably even for exciting or transforming non-virulent ones into true disease germs.

What now, let us inquire, are the clinical facts and probabilities bearing on this point? A consumptive person in an advanced stage of the disease coughs up and spits out vast numbers of bacilli: a fact that the microscope plainly reveals. These germs are often in a most virulent, poisonous condition. Without the utmost care, attached to invisibly minute particles of mucous, tubercular matter or destroyed tissue, they get scattered about the sick person and bed. The invisible particles, with the germs, soon—probably in a a few minutes—become dry enough to be carried with the air breathed into the lungs of an attendant. The germs have not been exposed to light and air long enough to have lost any of their vitality or virulency In the tissues and fluids of the new field—the new body, rendered susceptible or predisposed by long vigils, night and day, in probably a close, over-breathed atmosphere, with many months or a longer time of limited respiratory action and want of oxygen, and with a break or abrasion in the defensive wall of the mucous membrane of the minute brochi, the seeds fall upon (to them) fruitful soil. Here, active, full of venom,—if the figure may be permitted, excited and gory, fresh from the battle-field—they set up, probably in spite of much resistance, the inflammatory action which results in the formation of tubercle. A case of this nature would be unquestionably one of infection or contagion, or, if another term be preferred, inoculation. Who can doubt that such cases not infrequently occur?

With these facts and probabilities, and with the many special cases of the disease reported by various authentic observers as having had, seemingly, their starting point in this way, at the bedside, is it reasonable to deny or doubt the infectiousness or direct communicability of consumption? Yet, nevertheless, as we have seen, some physicians of high standing, apparently not many, still question it. It seems to be clearly established, however, and now very generally believed, that altogether in not a few cases of the disease, possibly in many in certain localities, countries or peoples, its germs had been communicated, and by means of the atmosphere breathed, direct from a person affected with the disease, somewhat as above pointed out. The theory of the infectiousness of consumption, therefore, should be considered as established beyond reasonable doubt. The disease has been classified with such other infectious diseases as typhoid fever and Asiatic cholera (Doctor Thomson: New York Acad. of Med.), as a "non-contagious communicable disease." It has been estimated that about eight hundred tubercle bacilli are necessary in ordinary circumstances for the successful inoculation of a rabbit. The number required to infect a human being could hardly be approximated, but would obviously vary greatly with circumstances, especially with the degree of virulency of the bacilli and the condition of the soil or host.

CHAPTER IX.

CAUSES OF CONSUMPTION CONTINUED. SOURCES AND DISSEMINATION OF THE BACILLI.

TUBERCLE bacilli, and doubtless their spores also, are given off from a consumptive person most abundantly with the expectorated matter coughed up from the lungs—the sputa (spit). In consumption of the bowels, they are given off with the bowel excreta. There is evidence that they may be cast out by the perspiration, through the skin, and also with the urine, and spores possibly pass off with the breath.

Tuberculous animals are a source of the germs. The flesh and milk contain them; and doubtless the various excretions also.

With all these known sources of tubercle bacilli, who can escape taking them, sometimes, or often, into the body, either by inhalation or swallowing?

There are, too, a number of ways in which these germs, whether active and virulent or dormant and non-virulent, are spread about—disseminated on every hand. They may then be conveyed to human bodies by air currents, especially with and forming part of the ubiquitous dust, and by solid bodies of almost any and every kind,—clothing, bedding, money, public

conveyances, etc., etc. They are not known to spread by means of water; but are doubtless often communicated to human beings by the milk and flesh of tuberculous animals used as food.

HUMAN SOURCES OF THE BACILLUS.

The number of tubercle bacilli given off daily by some consumptive persons is so enormous that it would hardly be credited were it not that they have been repeatedly subjected to actual count; that is, counted in certain portions of the sputa. The number varies greatly with the nature of the case and stage of the disease. Twenty millions is about the lowest estimate. On the other hand, Osler (Prac. of Med.) records that a patient of his in the Johns Hopkins Hospital, Baltimore, Md., "moderately advanced," in sixteen counts, during a period of a few weeks in January and February, spat out from one and a half to four and one-third billions of bacilli daily, contained in from about a pint to a pint and a half of expectorated matter. Amongst every one hundred thousand of the population there are constantly, on an average, two or three hundred suffering from consumption. These people cast out thoughtlessly, carelessly, almost criminally, always most disgustingly, anywhere, everywhere, just as temporary convenience suggests, or occasion and circumstances permit, or do not forbid —upon the floors of rooms and shops, public halls and other places of public assemblage, in public conveyances, upon the sidewalks of the streets, and in back yards—countless billions of the infective bacilli,

besides their probably still more numerous spores. The sputa containing them soon dries, and, probably often encased in and protected by a coating of dried mucus, they are set free. What becomes of them, of these countless myriads of invisible particles? They are carried by air currents hither and thither, lighting on our food and flitting with the breath we draw into our lungs.

Samples of dust were collected by Cornet from many and various sources, especially from the walls and floors of wards and rooms which had been occupied by consumptives. Of one hundred and eighteen samples of that dust, forty were infective and produced tubercle in animals inoculated with it. Praussnitz collected dust in *coupes* of trains running on a road frequented by consumptives. Inoculated into five guinea-pigs, the dust produced tubercle in two.

In consumption of the bowels, too, doubtless enormous numbers of the germs are cast out by the fecal discharges, which eventually dry up and set free particles with living germs. Doctor E. Solles produced tuberculosis in guinea-pigs by inoculation with the feces and urine of consumptive persons. Professor Graham says the bacilli have been found in considerable numbers in the perspiration. They adhere to the skin, and are not found when the surface is kept clean and disinfected. This would indicate that they come from other sources and settle on the skin. It is most likely, however, that they are washed out of the body by the perspiration.

HOW THE BACILLI ENTER THE BODY: INHALATION.

There are four avenues by which tubercle bacilli may get into the body: (1) Inhalation—the air passage route to the lungs with the air and dust breathed; (2) Swallowing—the food passage way to the stomach with the food, or when carried to the mouth or throat by other possible vehicles, as the fingers, pins, money, etc.; (3) By direct inoculation through the cutis, into or under the skin, as through a cut or scratch; (4) Congenital means, from a parent.

From the fact that in tuberculosis the lungs are the organs much the most commonly affected, especially amongst adults, it is generally believed by authorities that inhalation by the air passages is the most common way in which the germs of the disease are received into the body. Some writers have conjectured difficulty in the germs thus reaching the remotest recesses of the lungs, but it is not easy to understand how there can be any obstacle whatever to their passage in, along with dust, which is so constantly breathed. That this is one way of entrance has been fairly proved by the experiments of Tappeiner and Bertheau upon dogs. The very beginning of tubercular formation, too, is often in the smallest bronchial tubes, which open direct into the air chambers.

Next in importance is infection by way of the digestive tract with the food. The microbes may be conveyed into the mouth in various ways, perhaps by the air in breathing through the mouth, whence they are conveyed into the stomach by swallowing. A

case has been recorded in which the water that some grapes had been washed in produced tubercle in animals inoculated with it, the grapes having been outside the door of a fruit store, exposed to street dust. The most common vehicle, however, in which the infection is conveyed into the stomach is probably the flesh and milk of tuberculous animals, an important part of this question to be presently discussed.

Direct communication of the germs by accidental inoculation is not a common method of spreading consumption, although a large number of cases, in all, of this kind have been recorded. Doctor Heron gives details of many cases of such inoculation, in various ways. The disease has been communicated many times to man through a slight wound in making examination of tubercular dead bodies, of man and animals. Surgeons have sometimes suffered seriously in this way. Pfieffer recorded a case of a veterinary surgeon who, in 1885, was cut whilst making a post-mortem examination of a tubercular cow. The wound healed readily, but six months after, a small tubercle was found near the part, and some months later the man presented symptoms of pulmonary tuberculosis; of which he died two and a half years after receiving the wound. A few years ago a case was mentioned in the British Medical Journal of a young girl who contracted general tuberculosis from wearing the ear-rings of a friend who had died of consumption, the infection having been apparently communicated by way of the pierced ear.

The communication of the disease by the parent to

the offspring has been already sufficiently discussed in connection with the subject of heredity.

In whatever way the infection is taken into the body, it is commonly spread to other and various parts of the organism; and, it appears, by and along the course of the lymphatic vessels rather than by the blood vessels. Whether the bacillus, after getting into the body, has any special predilection for the lungs, is not yet known. It seems evident, however, that in whatever way the infection gets in, if it give rise to tubercle, the lungs eventually, in nearly all cases, become affected with it.

INTERCOMMUNICABILITY : INFECTION FROM ANIMALS.

That consumption may be communicated from man to the lower animals and from such animals to man has long been believed, and now appears to be a well-established fact. As already has been stated, tuberculosis in the bovine race, once known as the "pearl disease," is now universally regarded as being identical with the tubercular disease in man. The bacilli in the two cases are indistinguishable under the microscope, while their growth in various culture substances and their biological characteristics are identical, except that the bovine bacillus is usually smaller than that of man, although in cow's milk it is as large.

There is conclusive evidence that the disease is communicable from man to the domestic animals. Besides instances of observation in which it seems clear that poultry contracted tuberculosis by eating tuberculous expectoration from human lungs, the

disease has been produced time and time again in animals by intentional inoculation.

As an example of probable communication of the infection from the human body to animals, the following will be of interest. In the Lancet (Lond.) of January 16, 1892, J. Armstrong, M.B., of Liverpool, Eng., reports that a boy, a patient of his, with a tuberculous family history, died at the age of fourteen, of consumption. He had a pet dog and a pet rabbit which were often about and on his bed during his illness. Both animals soon became affected with cough and died shortly after. A veterinary surgeon made an examination of the bodies and pronounced the cause of death to have been tuberculosis.

THE BOVINE RACE A SOURCE OF THE BACILLUS.

Doctor E. F. Brush, of Mount Vernon, N.Y., who is a stock raiser, and has long devoted attention to this subject, believes that tuberculosis "is all derived from the bovine race" (Paper, N. Y. Med. J.). He suggests that as the temperature of bovine animals is higher than that of the human body, the tubercle bacillus finds in them the most congenial soil. "We are veritable parasites on the cow. . . . She has tuberculosis and we have tuberculosis. . . . The inhabitants of the steppes of Russia, who have no cows, have domesticated the horse, using its milk, meat and skin, and a case of pulmonary tuberculosis has never been known amongst them. The Esquimaux have neither cows nor pulmonary phthisis." It appears, according to Doctor Brush, that where the dairy cow is unknown,

consumption does not prevail, but that on the other hand, the disease is common where the cow is in common use, and many countries are named to corroborate this.

Evidence, too, that a certain amount of relation exists between the prevalence of this disease in man and that of bovine animals is afforded by a chart issued in the year 1881 in Baden. The chart applies to fifty-two towns, and shows that where tuberculosis was prevalent among cattle, it was proportionately prevalent among the human population, and was particularly so in towns in which the number of low-class butchers was greatest. In a debate in Parliament in Great Britain, a few years ago, Sir Lyon Playfair pointed out that it is a "significant fact that when tuberculosis in cattle increases, consumption of some form or other—but especially of the mesenteric and intestinal form—also increases amongst children." All this at least affords evidence of the communicability of the disease from animals to man.

FLESH AND MILK SOURCE OF INFECTION.

That consumption could be communicated to the human body by means of the flesh of tuberculous animals used as food has been evidently suspected from the earliest records. There existed strict Mosaic laws condemnatory and prohibitory of the use of the flesh of animals affected with the disease. From that time onward to the present various ordinances have been instituted with the same object.

It has been argued that there is no direct proof

of the transmission of tubercle from animals to man by the use of flesh and milk as food. Such proof, urges Professor Walley (Royal Vet. Col. Edin.), "cannot, for manifest reasons, be obtained, but the mass of indirect proof in favor of such supposition is enormous." He mentions a striking example of the effect of eating the flesh of tuberculous animals, brought to light by a French physician, in the case of a young woman who rapidly became consumptive as the result of eating the imperfectly cooked bodies of tuberculous fowls. Doctor C. R. Drysdale, a few years ago, in the British Medical Journal, drew attention to a fact in his experience, viz., that in the Metropolitan Free Hospital, London, "it was very rare indeed, even in the poor Jewish quarters of Houndsditch, to meet with Jews afflicted with phthisis, a disease so prevalent among the ordinary population of that district." This exception is attributed to the care taken by the Jews in the inspection and selection of meat.

The question of the infection being conveyed by milk is, perhaps, of even greater importance than is that of infection by flesh, for the twofold reason that it is so largely consumed by infants, and this generally in an uncooked state. The danger of contamination by milk will be more clearly comprehended when it is known that the tubercle bacillus can be readily detected in the milk of animals in whose udders tubercular lesions exist; and also, as shown by Professor Bang, of Copenhagen, in that of women whose mammary glands are tuberculous. Of

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six hundred cows examined by Doctor Woodhead and Professor McFadyean (of Gov't. Bd., Gt. Brit.), in six cases they demonstrated the presence of tubercle bacilli in the milk. Professor Walley says, "In 1872 I lost a child in Edinburgh under circumstances which allowed but of one explanation, viz., that he had contracted mesenteric tuberculosis (consumption of the bowels) through the medium of milk." A Mr. Cox, of the Army Veterinary Department, England, has related the particulars of a case which led to the same conclusions; as also has Mr. Hopkins, F.R.C.V.S., of Manchester. Fleming (Vet. Med.) has referred to a similar case as occurring in the child of a surgeon in the United States. Walley reports a case of mesenteric tuberculosis from the use of milk which occurred in the child of a well-known veterinary officer of the Privy Council. At a meeting a few years ago of the Edinburgh Medical Society, Doctor Woodhead referred to some undoubted cases of transmission to man, and also to the pig, by the medium of milk. Many other cases of a similar character have been recorded. A striking case has been reported by Denune, of Berne (Med. Press & Circ.). An infant aged four months, with no tuberculous tendency, died of tuberculosis of the bowels, the bacilli being found in the glands. The child had been fed with only milk from a cow which was then killed and found to have tubercles in the lungs, while milk pressed from the udder contained tubercule bacilli. Finally, quoting the words of Professor Adami (Paper, Montreal Med. Soc., Mar. '93), "Intestinal and abdominal tuber-

culosis is most common, as we all know, in the young, and the prevalence of milk diet indicates what Bang in Denmark, Bollinger in Germany, Nocard in France, and Woodhead and McFadyean in England, have conclusively proved to be the case, that this intestinal tuberculosis is very largely brought about by the milk of tubercular cows."

According to Bang and others, the cream, butter, cheese and buttermilk from tuberculous cows have been shown to be as infective as the milk, if not more so. It seems that the milk may be so sterilized as to render butter and cheese therefrom comparatively safe. It is possible that the spores may survive the sterilizing process. The only absolute safety is, probably, in healthy cows or immune human bodies.

CHAPTER X.

CAUSES OF CONSUMPTION CONTINUED. DE NOVO ORIGIN OF THE DISEASE.

Now as to whether consumption always, frequently, or only occasionally, arises by way of infection —communication by virulent germs from another case of it—and if not always, in what manner do the other cases arise, is a very important question, and one which, so far as I know, has never yet been specially discussed. In ordinary general practice, we find but comparatively few cases at the most which can be traced to infection; not nearly so many as we can so trace in cases of outbreaks of typhoid fever, the least infectious of the febrile diseases. It will be conceded, probably by the most ardent advocates of the infectiousness of consumption, that at least many more cases of the disease develop by other means than by ordinary infection which can be traced. How or in what manner do these large majority of cases arise?

DOES THE BACILLUS GROW OUTSIDE THE BODY?

We have seen that there is no consumption without the tubercle bacillus. It is not known that this bacillus grows outside the body of a living warm-blooded animal, except by cultivation in the labora-

tory; while it is believed by Koch and other high authorities that it does not. There is, however, doubtless much yet to be learned in relation to this micro-organism, especially as to its botanical history. Sir Hugh Beevor has shown that it will grow at a temperature of 60° F.: although it is generally supposed that it requires that of 95° or more. May it not, then, like many other, if not all, disease germs, the life history of which is best known, propagate outside a warm-blooded body? The bacillus of splenic fever (anthrax), as already stated, "ordinarily completes its developmental cycle outside the animal body" (Koch); and the bacillus of typhoid fever and of cholera probably do so,—at least they propagate in milk and other fluids; while it is probable that the infective organism of diphtheria is also of a like nature in this respect.

The question may be asked, is the simple, single bacillus, or little stick-like and best known form of this fungus (the tubercle bacillus), the ultimate, complete, natural form or condition of the vegetation? Probably not. Nearly all these simple forms of life have a more complex and complete state of existence, if only as a cluster or mass, even zooglœa—a gluey or gelatinous clump or colony produced by most bacteria whenever they are allowed to flourish unmolested. We have seen that the star fungus in actinomycosis, or "lumpy jaw," of cows, presents a daisy-like form. Branched and other forms of the tubercle bacillus have been observed. And in what phase are these bacilli in the dull, whitish, scale-like growths on blood serum

in the test-tube? Or when appearing, as Ball says, like "crumbs of bread moistened;" or as a Klatsch preparation, with "a thick, curled-up centre around which threads are wound in all directions?" It is not possible for the bacillus to take on any such form in its parasitic life in a living body because of the antagonistic vital forces of the host. Is it then, as Koch says, always a "true parasite" which "cannot live without its host?" Or is it only an accidental or occasional parasitic organism when in its simplest phase? Has it a more flourishing vegetative condition, approximating the mould formations, for example:—perhaps on "culture media" of minute particles of human excreta, as sputa, and in dark, damp, secluded, confined spots in unhygienic dwellings, cellars or closets, or elsewhere, outside of dwellings? In some such conditions the infection of diphtheria and of typhoid fever and cholera are supposed to lurk and flourish.

Since these pages were written, and apropos to the above, I see in the British Medical Journal (Mar. 9, '95: Epit. of Current Med. Lit.) editorial comments on "a detailed account" of the various forms of this bacillus and its biological position, by Coppen Jones, already referred to, as follows: "A number of observations are mentioned, which tend to show that bacteria . . . are only stages in the development of more complex forms. The author thinks we ought to hesitate before accepting the common view that the exciter of tuberculosis is a parasitic organism, which is transmissible only from animal to animal, and

which is without vegetative existence external to the animal body."

Again, in a paper by Doctor Arthur Ransome, F.R.S., in the Proceedings of the Royal Society, Eng. (Vol. XCIX.), "a series of observations are given to prove that fresh air and light and a dry sandy soil have a distinct influence in diminishing the virulence of the tubercle bacillus." "Mere exposure to light in otherwise insanitary conditions does not destroy the virulence" (Lancet, Jan. 16, '92). Now, why would the virulence diminish on a dry sandy soil, and not in "insanitary conditions?" Is it because such soil affords no decomposing organic matter, as food for the saprophytic requirements of the fungus, such as afforded by other soils, or insanitary conditions? Why, if the fungus does not grow outside the living animal body? We must bear in mind that reliable statistics prove beyond doubt that consumption is less prevalent on sandy soils than on heavy damp soils. Doctor Flick, who has long made a study of the subject of the infectiousness of consumption through the spread of the bacillus, says (Pamph. on Contag. of Phthis.), "I have no doubt that it [the bacillus] will propagate in decaying matter of any kind, and that it can thus perpetuate itself indefinitely." The opinion of Mr. Chandler, in his book on Prevention of Consumption —that it grows "free in nature," outside the body— has been already mentioned.

Now, if this bacillus in another phase of its existence, does not grow (and, it may be, best or most naturally) free in the open air, like most other fungi,

and as in the case of the so-called malarial germs and those of splenic fever, it seems at least possible that in certain other and more favorable conditions, as in warm, dark, protected "corners," it may live a long time and multiply or propagate its species. Possibly it may be a tropical plant and not yet fully acclimated to the frosts of temperate regions.

A POSSIBLE LOWER ANIMAL ORIGIN.

In considering the subject of the prevention of consumption, it seems necessary to consider possibilities, and, indeed, in practice, to act upon possibilities. There is, therefore, one more closely associated point to which I shall venture to refer in this connection. It may be generally looked upon as rather speculative, but perhaps in course of time it may receive more consideration. It has long seemed to me that all living so-called disease germs may have been derived through or from the lower animals. Such of the microbes as may have lived originally, like most known saprophytic organisms do, free outside a living animal body, have become, accidentally, occasional so-called parasites in certain of these animals: and, it may be, only after, and chiefly by reason of, the less natural and more unhygienic conditions of the animals arising from domestication. If any there be of the germs which never had so lived—free, outside the animal body—then, it may be, they were originally, when in the animal body previous to domestication, benign organisms, working out their destiny in the endless chain of events "which sustains the

equilibrium of nature," that nothing, not even a particle of excrement, be lost; and because of the insanitary conditions associated with domestication they eventually become poisonous, virulent, parasitic, pathogenic.

As we have seen, it has been suggested (Doctor Brush) that the bovine race may be the original source of the tubercle bacillus, as it is apparently of the infection of vaccinia and small-pox. May it not be, if this bacillus never has been a free, air-growing fungus, that in bovine animals, in their more natural state, it is a benign organism or saprophyte, somewhat as the bacillus coli communis is, usually, it appears, in man? Reference has already been made herein to the remarkable effects on these micro-organisms of the diet and other conditions and habits of life of their host. May not the domestication of these animals, with the usual unventilated, often dark, dank and uncleanly byres in which they are housed, with want of more active, general, and fuller respiratory exercises, and their changed, more fat-forming and less invigorating food, have caused the degradation of the bacillus—the gradual "cultivation" of it into a virulent, pathogenic organism? Becoming virulent and pathogenic in the cow, the tubercle bacillus, on being conveyed into the body of certain human beings, becomes perhaps still more poisonous and virulent. The question may be asked, do not the methods, or the measure of success attending the methods, by which it is now sought to protect man from the effects of disease germs—to render him

immune—by inoculations with the diluted products of various microbes "cultivated" in the body of animals, whence possibly they came favor the view that man originally received them through or from these animals?

Again, it may be asked in this connection, what explanation can be given of the long period of so-called latency of the tubercle bacillus in the human body, and especially of the young—the period in which it apparently does no harm, as referred to elsewhere? Is the microbe, then, absolutely inert, dormant, inactive? Is it in a condition not at all in accordance with its nature? Can this condition of it arise from any still inherent trace of its benign nature—be an instance of something like atavism? We must await replies to these questions until we know much more of the botany of the plant.

CONSUMPTION NOT ALWAYS FROM INFECTION.

Now, whether the tubercle bacillus grows free outside the living warm-blooded animal or not, or whether or not it comes to us wholly, or only in a measure, from the domestic animals, there is, in any case, at the present time a superabundance of the microbes and their probable spores scattered about everywhere by consumptive persons. They become dry, and the air and sunlight modify and eventually, doubtless, destroy their virulency, although not in all cases their life, especially in the case of the spores. They are carried about with, or as particles of, the invisible dust of the atmosphere. Douglas Powell

says, "It cannot be doubted that they and their spores form some practical proportion of the organic elements of dust." Nor can it be doubted that most persons, if not all, occasionally, probably often, draw in with the air breathed one or other form of the microbe—the parent rods or their spores—by hundreds or thousands. They lodge on the cilia of the bronchial tubes, possibly on the walls of the air chambers: this without any harm or inconvenience whatever to a very large majority—from seven-eighths to three-fourths—of the population. With the minority—the rest of the people—however, it is quite different. In these persons who, we say, are in a susceptible condition of body—predisposed to the disease—whose fluids and tissues are in a certain favorable condition, the inhaled bacilli or spores become again poisonous, virulent, and eventually tubercle—consumption, is produced. Should cases arising in this way be regarded as having an infectious origin? The disease does not so arise in individuals in even fair or average health, and on exposure to the infection in a diseased person; nor, be it observed, from germs at the time virulent or infectious, apparently, for they do not infect the great majority of persons. The germs are not communicated as an infection in the ordinary way. They have lost in a measure, if not entirely, their virulency, or, in ordinary conditions, their infectiousness, by exposure to the oxygen of the air and to sunlight. A change has taken place in them outside the human body. They are practically, even actually, in another state (if not phase) of existence.

They are not infectious until made so by a certain condition of, or something within, their host. In such cases we regard the disease as arising *de novo*—anew, over again: not without the essential germ, but from a transformed, modified, non-infectious one.

We have the analogue of this in outbreaks, not infrequent in crowded parts of cities, of typhus fever. "Given a sufficient amount of overcrowding, want of ventilation, and insufficient or bad food and typhus is sure to arise." The germs which set up the disease "in a convenient soil are always present among us." They "only require the concurrence of the circumstances" just mentioned (foul air and bad food) to "enable them to increase and multiply" (Carpenter). So, too, the germs of consumption are ever abundant around us, and only require to meet with tissues and fluids surcharged with germ-food and probably toxic substances formed from the accumulated products of imperfect respiration.

OVERSIGHT AND ISOLATION NOT SUFFICIENT.

Now, to what extent will notification and oversight, or isolation, with disinfection or destruction of sputa, prevent or lessen the frequency of cases of consumption arising in this way—practically, at any rate, *de novo?* A certain amount of oversight for educational purposes, chiefly, would doubtless be very useful. In time, only after decades, probably generations, of effort, the effect of such measures would be perhaps clearly apparent; hardly sooner. Consumptives, in the early stages, careless, indifferent, and also pur-

posely concealed cases—persons objecting to submit to even oversight—would continue to provide and spread about myriads of the germs, which would continue to be ubiquitous, almost as at the present time.

Furthermore, it must be remembered, as above intimated, that in the application and exercise of preventive measures, in order to make sure of success, and the largest measure of it, we must be prepared for probabilities, and even possibilities. It is at least possible that the tubercle bacillus may grow and propagate outside the animal body. Of what avail then the destruction of the sputa? True, this point is met in a measure by general public sanitary administration promotive of cleanliness, etc.: but in the case of a possible free, air-growing tubercle bacillus, met only to a very limited extent.

Now, are we not forced to the consideration of the body factor, the "personal equation?" This factor may be fairly, indeed must be, looked upon practically and actually as the immediate, exciting cause of the disease.

THE BODY FACTOR:—PRETUBERCULAR CONDITION.

Reason leads to the clear conclusion that in the human body the tubercle bacillus (alike with other disease germs) is not "at home." The human body is not the habitat of the fungus. In an absolutely healthy human body it will not grow. The body in a certain diseased state, however, which may be termed a pretubercular condition, provides a soil—food, etc., and so causes the microbe to "take root" and propa-

gate in it. Something of the nature of this diseased condition, and the cause of it, it has been my endeavor in the foregoing pages to point out. Briefly, it is probably caused by, and is the effect of, certain toxic combinations or substances formed in the body from respiratory products accumulated therein by reason of a too limited respiratory function and consequent want of oxygen in the body; somewhat as anæmia and chlorosis are effects of certain toxines formed from intestinal accumulations, and as a predisposition to typhoid fever or cholera, is caused, in all probability, by other of this class of toxines.

We have, then, as the earlier effect of the limited respiratory function, this pretubercular condition—an actual diseased condition, indeed, which always precedes the formation of tubercle. This condition is well and generally recognized, and has been termed the "pretubercular stage" of the disease, although the disease—tuberculosis—has not yet commenced. It is commonly looked upon as following, instead of preceding, the first formation of tubercle. The symptoms, or signs—for they are more frequently observed by the friends than by the individual manifesting them—of this pretubercular condition are familiar to all. The three usually most noticeable are a certain amount of languor and depression with want of energy, a failure in the appetite for food, and loss of body weight. Sometimes one of these is first noticed, sometimes another; sometimes, probably most commonly, in the order above named; sometimes the reverse. Treat a person in this condition with tonics, cod-liver oil

and other nutrient remedies, and he, or she, will probably improve for a time, or temporarily, with this treatment alone, but not permanently or in a marked degree. Induce such person to inhale an abundance of oxygen in the pure outer air, and in a few weeks of this out-door life, and often without any other remedy or change, the condition is replaced by one of health. The cause of the condition is hence plain.

THE BODY CONDITION MUST BE PREVENTED.

Sanitarians in their efforts to prevent consumption, and physicians in their efforts to cure it, must recognize to a greater extent than heretofore this body factor, and overcome this condition. Indeed, in order to be most successful in such efforts, this factor must be regarded as the most important one, and be made the point of first and most vigorous attack.

Prevent or remove the pretubercular condition by increasing the respiratory function, and there will be no consumption; but instead, most likely, good health on the part of these persons. Destroy and prevent the growth of the germs only, and this pretubercular condition of the body will develop into something possibly worse than consumption—cancer, it may be, or other specific disease. Some other saprophytic micro-organisms will take possession of the rich soil and dwell in it, or make warfare there. We cannot live unhygienic lives and by simply destroying the so-called disease germs retain good health. W. Roger Williams, F.R.C.S., who for some years has given much attention to the relationship between consumption and

cancer, and promises a book bearing on the subject, writes as follows, although in a different order of sentences, in a recent number of the British Medical Journal (Nov. 3, '94): "I regard the predisposition to cancer as closely allied to the tubercular predisposition, of which in all probability it is but a diluted form. No heritable condition is more favorable to the development of cancer than that which predisposes to and accompanies tubercle. A large proportion of cancer patients are the surviving members of tuberculous families. The great increase of cancer during the last half century has coincided with a remarkable decline in the death rate from tuberculous diseases, especially phthisis. It seems to me exceedingly probable, from considerations derived from the study of the family history of cancer patients, that a large proportion of those thus saved from tubercle eventually perish from cancer and insanity; and I think the increase in the latter disease has been largely brought about in this way."

DEDUCTIONS: CONCLUSION OF PART I.

The following are my conclusions deduced from the facts and inferences set forth in the preceding pages:

1. That the tubercle bacillus is an absolutely essential factor in the causation of tubercular pulmonary consumption.

2. That the tubercle bacillus will not propagate or give rise to consumption unless there be already in the body tissues special soil-food for its growth, and

also, apparently, some special morbid condition or substance, probably a toxine, which is essential to its action as a pathogenic parasite.

3. That this special soil-food and probable germ excitant, or tissue irritant, are produced in the body from the decomposition of waste, effete matters accumulated therein by reason of the respiratory function being below a certain proportionate health standard, with a consequent limited supply of oxygen.

4. That the tubercle bacillus manifests various degrees of virulency, and in certain conditions, as when recently from the lungs of a person in an advanced active stage of consumption, it may infect a susceptible person much in contact with such consumptive, as in the case of a devoted nurse; also, when in flesh and milk in a recently virulent state, it is liable to infect susceptible persons using these substances as foods: many more cases of the disease, however, arise, practically, *de novo*—from revived or transformed non-virulent germs—than arise by such form of infection.

5. That the practical point is, not so much the precise nature of the immediate cause of the pretubercular condition, or body factor, as that this arises from, or by reason of, a diminished respiratory function, and is, rather than the bacillus, practically the exciting and more controllable and preventable cause of the disease, and should be so regarded in preventive effort.

True, a new field for preventive work is above indicated; yet one not so difficult of successful cultivation as some may suppose, or on first view it may

appear to be, as I hope to be able to show in future pages herein, when on the subject of prevention.

The fact is, millions of the units of the human family die, primarily or remotely, and literally, from "want of breath"—from a want in relation to breathing—die after years of suffering from this cause.

In the present condition of the masses of the people, with the limited character of many occupations, amongst nearly all classes, so many being employed in-doors and at work in which a stooping lung-contracting posture is temporarily the easiest, there is a consequent, common, almost universal, limited breathing movement and function. From this, along with the too common practice of almost constantly breathing an in-door, already overbreathed atmosphere, deficient as it is in oxygen as well as befouled, a large proportion of the masses, while suffering from rebreathing the poison in such atmosphere, suffer incalculably from a want in the body of that most vitalizing, purifying, invigorating element. oxygen, and the consequent retention of waste matters in the blood, obstructing all the vital functions. They are deficient in that vitality which a sufficiency of oxygen (aptly, in the beginning, by its discoverer, termed "vital air") gives, and which in turn gives zest and enjoyment to life and makes it "worth living;" while they are, too, from the same cause, predisposed, and too often fall ready victims, to various other forms of disease as well as to consumption. They are poisoned by their own excretions—their own used-up, waste matters retained in their body. So consequently they

suffer on, and eventually die, from a want of that element which, when properly consumed and utilized, gives general healthy, vigorous, unobstructed functional activity—briefly, from "want of breath."

It is true, there are many other concomitant or conjoined causes which aid in bringing about this depressed, half-alive, specific disease-producing condition of so large a proportion of "civilized" mankind. The foul air is never quite alone in causing disease. It has many confederates. Boon companions of it are, commonly, an unclean dormant skin, improper diet—badly prepared, badly cooked and excess of food, darkness and dampness in dwellings, incontinence, tobacco and whiskey. Still, however, the rebreathing, again and again and again, the already breathed and rebreathed air of closely enwalled, unventilated sleeping, living and working places and schools, and breathing such an atmosphere with but small or contracted or half-used lungs—in short, the imperfect performance of the all-important function of respiration—incomplete exchange of bodily waste for oxygen, is commonly the starting-point of the too generally depressed vitality and want of full health and vigor among the masses, and of many other ills as well—intemperance, insanity and crime—which follow. The most marked, probably the greatest, health want of the age is fuller, freer breathing of purer air.

PART II.

PREVENTION OF CONSUMPTION.

CHAPTER XI.

THE prevention of consumption is the special object of this book. It is not the intention that the preventive measures to be discussed shall be applied only by and to individuals, or that each individual alone may be able to prevent the disease in his or her own person. There is a much broader aspect to the question, to be kept in mind. It is a great public question, involving indeed the eventual stamping out altogether, practically, of this most destructive of all diseases. The motto, the rallying cry, of sanitarians and all who are interested in the public welfare, or in their own health and that of those near and dear to them, should be PREVENTION, always, on every hand and in every way, rather than cure. Philanthropists give large sums of money for hospitals for the treatment, with the intention of cure of disease, too often, alas, only the intention, however laudable, many cases being too bad or reached too late. Who will be first to give of their abundance such sums for direct prevention?

PRACTICABILITY AND FACILITY OF PREVENTION.

Particularly in respect to consumption is preventive rather than curative effort desirable: and for two reasons: first, because of the great fatality and immense pecuniary cost of the disease, and second, because of the comparative facility with which it may be prevented. It is, indeed, singular that more special efforts have not been made by sanitarians in behalf of its prevention: one-fifth or more of the human race, as already stated in the introductory, being destroyed by it alone, in its various forms, besides its prevalence in domestic animals; while from the long periods of debility and sickness to which it gives rise, the loss of time and money outlay are much greater than from any other disease, and all this besides the direct personal suffering and bereavements from loss of relatives, commonly in manhood's or womanhood's prime.

Consumption is comparatively easy of prevention because (*a*) the body factor in its causation being essentially more specific than in most other infectious diseases—the seed requiring a more special fitting soil in which to grow—its intended victims may be in a large measure picked out from amongst the people and the armor of prevention thrown around them: and (*b*) because the seed or germ is comparatively easy of destruction. Howard Marsh, F.R.C.S. (of St. Barth. Hosp., Lond.: in Brit. Med. Jr.) recently said, "Progressive and destructive as the tuberculous process is, when the tissues which it involves are suitable for its

development, and when its environment is favorable, the tubercle bacillus is, nevertheless, an organism of such low vitality, and so dependent on surrounding conditions, that it is frequently placed by influences with which we are at present imperfectly acquainted, at a fatal disadvantage, and thus is destroyed and eradicated by the vital forces by which it is opposed. That it does frequently, as a matter of fact, thus perish, is well known." Destructive as the bacillus is when associated with, or stimulated or poisoned by, man's unhygienic conditions, habits and surroundings, its effects are usually after all but a mild, timely, slowly acting penalty for sanitary transgressions. Without the unhygienic conditions, it would probably be as harmless as the simplest mould.

That the predisposition to the disease in individuals, whether inherited or acquired, may be in almost all cases comparatively easily overcome and removed is well known. It would be easy for me to give the detailed history of many individual cases, as doubtless it would be, too, for most other physicians, in which a strongly marked predisposition—even the pretubercular condition—was entirely overcome in a comparatively short time by careful, well-directed hygienic measures.

In England and Wales, by the usual public health measures for the prevention of disease generally, the mortality from consumption was reduced in a period of about twenty-five years (1864-88) by nearly one third. By more special general and personal preventive efforts, doubtless the mortality could be much more largely reduced in a few years and eventually

the disease practically eradicated. In armies and navies, too, in Europe the prevalency of the disease has been greatly lessened by means of provision for more pure air, alone—more space in barracks and better ventilation.

Who then will be first to start a fund for the timely prevention of this "great white plague"?—let us say for building sanitaria, or a sanitarium, even one as a model, for practically teaching people to stand erect, as by nature or the Creator designed; to breathe properly and freely of only pure, sunny air; to cleanse and invigorate their body by means of baths and suitable exercise and food as well as by oxygen: for teaching them how to remove and prevent the predisposition — the prepared, fitting soil for the tubercle bacillus—a soil so prevalent on every hand and especially among the less well-to-do and less educated of communities who are not in a position of themselves to so help themselves; for teaching them, and perhaps first of all, the intrinsic, pecuniary value as well as comfort of good health. Unquestionably it is in the badly formed, badly functioned, impure human bodies, and not in the simple fungoid plant, that the root of the evil lies, and where the axe must be laid; and it is quite practicable to successfully strike at the root.

PRINCIPLES OF PREVENTION: LINES OF ACTION.

The question then is, HOW may consumption be most effectually prevented? The principles of prevention may be largely inferred from what has been recorded herein respecting the causes of the disease.

It will be remembered that in its causation there are two chief or primary factors, namely, (1) the tubercle bacillus — the infecting agent, and (2) the special morbid body condition in which only the bacillus will grow and give rise to tubercle; in other words, the seed and the fertilized soil. In prevention, the aim must be to remove or destroy the causes. While we endeavor with one hand to destroy the bacilli, with the other we must endeavor to purify, invigorate and fortify individual bodies in order that there shall be no fit soil in which, by the growth of the bacilli, tubercle can be produced.

It appears to me that greater success in preventing consumption, particularly, while preventing other diseases, too, will be attained by keeping in mind, rather than the bacillus, the thousands of defective human bodies which provide the condition—the soil —for its growth therein; and by marshalling opposing forces mainly against the causes which give rise to this body condition, whether inherited or acquired. Let us then first consider, as being the more important, methods for preventing the production of that particular, defective state of human bodies which is essential for the growth of tubercle bacilli,—how we may best combat the development of the so-called "predisposition."

Public health bodies, as well as individuals, must give more attention to this personal or body factor. It will be my endeavor to point out in future pages how this, in particular, may be best and most practically done.

PURE IMPREGNABLE BODIES FIRST.

Up to the present time, special measures for the prevention of consumption have been almost entirely confined to destruction of the bacillus, and the body cause has received little or no attention. If we bear in mind that a consumptive in a "moderately advanced" stage of the disease has been known to give off daily in the expectoration from the lungs—in the spittle, by actual count (in a given proportion), four billions of bacilli, besides probably countless invisible spores, and not including other sources of the germs, as the domestic animals and a possible open-air growth, we can readily see that destruction of these is indeed "no easy task." This is not so much the point, however. At any rate, extermination of infections, or seeds, should go on.

The late Sir Andrew Clark (lect. already mentioned) said, "Would it not be infinitely better for us to spend less of our time in what seems vain attempts to destroy those microphytes and more of our time in studying the character of the soil in which they will or will not grow? For all my experience points to the conclusion that it is mainly, if not entirely, through the influences which we may become able to exert upon the soil that we may best hope to control or to stay the progress of phthisis." Professor Blackader (of McGill) says, "We feel convinced that much more can be done by us as physicians in the way of prophylaxis by strengthening the barriers that nature raises against the intruders, than can be effected by any

or all of our subsequent therapeutic, antiseptic or germicidal measures." Doctor Burt, already cited, believes that, "In dealing with the disease, it is of primal consequence to keep in view the goal for which we may reasonably strive, namely, to elevate the tone of the tissues and the fluids that bathe them to a sanitary pitch, where they themselves are the best of germicides. Bacteria do not thrive upon such nourishment." And Doctor Carmichael (Exam. Pub. Health, Fac. Phys. and Surg., Glasgow) says, "Secure cleanliness, purity of food and of the air of houses, schools and workshops, and consumption, finding no fitting soil, will disappear."

In brief, the prevention of consumption consists principally in means for promoting good health and vigor—purity and tone of tissue, amongst the masses of the people. With the highest authorities, although for the most part looking upon the disease as infectious, the destruction of the infection—the bacilli—about which so much is being said and written, is of secondary consideration. The body factor is first.

Furthermore, as the reader has been already reminded, by improving the health of the masses individually, they will be enabled to resist the inroads of other infectious diseases, as well as consumption in its various forms; and, indeed, all diseases, even chronic "local" affections of the different organs.

Again, on the other hand, if we can materially reduce the mortality from this disease by extermination of tubercle bacilli alone, there will probably be a

proportionate increase in mortality from some other disease or diseases. Doctor E. P. Hurd remarks (ann. meet. Am. Climat. Assoc., '91), "Knowing that tuberculosis is simply a *blight* which *smites imperfectly nourished tissues*, I would urge that the efforts of the therapeutist [and sanitarian] be directed to the element of cellular weakness rather than of chasing the will-o'-the-wisp of a bacillus. Evict one hungry brood, and another more voracious and more malignant will take its place." In England, although the mortality from certain diseases has been reduced, from others it has about proportionately increased. As W. Roger Williams has pointed out (already cited), the increase of cancer has coincided with the decrease of tuberculosis. While there has been a large reduction there in the total mortality, from all diseases, this has been, it appears, almost entirely from prolonging the life of very young and less vigorous persons; and mostly by protecting them from infectious diseases.

Let me here repeat, we cannot have much success in the prevention of disease simply by destruction of so-called disease germs, while we continue, either as individuals in our own personal private acts and practices, or as communities, to transgress the laws of health—to live in our daily, hourly habits unhygienic lives—while we continue to provide in our bodies impurities—soil, for the growth of the germs. So infinitesimal are these and their spores, and so rapid their multiplication, they will continue to elude us and fall upon and grow in any good soil presented. Wherever

on the earth's surface there is "waste" soil, there weeds, from seeds the sources of which are often unknown and unknowable, will spring up, and spring up in spite of us; hoe them down, nip them in the bud, and they come up again or others spring up. Somewhat so it is with the seeds of disease. Sometimes when we desire to prevent the growth of weeds or grass through a gravel walk in our lawn, we endeavor to destroy the fertility of the soil beneath. Let us act on a like principle in our efforts to prevent disease, particularly consumption, the seeds of which are so peculiar in respect to body soil. Where the carcase is, there will the vultures be gathered together.

As individuals, Doctor E. Brown says, "We ought to learn to keep our bodies as invulnerable to contagion as a fireproof building is impervious to fire; that is, we should be able to resist such moderate quantities of disease germs as we ordinarily and necessarily encounter through life. While I would not detract one iota from the oft repeated cautions to avoid the external sources of contagion, I yet believe the mystery why one person escapes while another under the same exposure becomes a victim to contagion, is explained in the fact that one carries such a store of vital energy and pure blood that no lodgment for disease germs is found: while another by the impurities scattered through blood and tissue, invites disease to enter." And in the words of the Medical Record (N.Y.), "There is no greater protection against disease than a good physical condition, in which the stomach craves and digests food, the intestines, the

kidneys, the skin, and the lungs remove waste products promptly, the liver elaborates the crude nutrient material into the finished product ready for use in construction and repair, and secretes in abundance the antiseptic bile ; and, in short, the whole economy acts as one compact and well-disciplined army, with all its branches—the cavalry, the infantry, the artillery, and the engineer corps—working in harmony, each with the other, and each in its own particular sphere. Bacilli may then attack, and micrococci may marshall their forces in vain, the human citadel is impregnable, and the garrison within laughs at the liliputian host which seeks to do it battle."

It is to be feared that before any great success will result from the efforts of public health boards or other authorities to reduce the mortality or improve the standard of public health, more attention and care will have to be given in some way to the hygiene of individual bodies of all members of communities, old and young—to personal hygiene. This is entirely practical so far as instruction of the people in health requirements can be carried out; and most can be done, and doubtless, too, a very great deal, in this line of action. It is hardly more practicable to insist on good plumbing than on good ventilation. Public baths convenient for almost everybody would incalculably improve the public health. And through the schools much could be done by special measures for preventing asymmetry of body, and particularly and easily, between the lungs and other parts.

ATTENTION TO MINUTE DETAILS.

Now, while it is most desirable to avoid anxiety or worry, in any measure, about the health or the conditions which favor or interfere with it, it is, nevertheless, very desirable, especially for persons in any way predisposed to consumption, to give habitual attention to every detail relating to those essentials of health which will presently be discussed. To some persons this is natural, while many others are indifferent or careless and consult mainly their tastes and inclinations. An act or neglect, perhaps seemingly of little or no consequence, or a habit seemingly doing no harm, may exercise a decided influence on the functions of life, especially in a susceptible delicate constitution. It is well known that it is not uncommon for one or other of the body organs—kidneys, stomach, spinal cord—to become the seat of considerably advanced "local disease," possibly already incurable, from some act, or seemingly harmless habit, of the individual, as in respect to diet, occupation, sexual relations, or perhaps breathing, before any symptoms sufficient to attract attention are manifested.

That eminent abdominal surgeon, Mr. Lawson Tait, on addressing a meeting of the Canadian Medical Association, in reply to the question,—to what he attributed his success as an operator, said, in effect, to giving the closest possible attention to minute details in everything relating to both the previous condition of the patient and to the operation, especially as to absolute cleanliness. So it should be with individual

habits and surroundings as they bear upon hygiene. Sometimes in susceptible non-vigorous persons, and in others, too, the living out of the natural span, or even perhaps for a day, depends upon the condition of a few blood cells. Sometimes there are but a few of the most elementary particles between life and death: life "hanging" upon even less than "a thread."

Respecting the struggle which may take place in the human body between the natural forces and invading germs, Doctor Lauder Brunton says, "The result of the struggle may be determined, not by some powerful agency which weakens or destroys either the organism or the microbe, but by some little thing which simply inclines the scale in favor of one or the other. In the potato disease the victory of the invading microbe and the destruction of the potato, or the death of the microbe and the health of the tuber, may depend upon some condition of moisture or possibly of electrical change in the atmosphere which aids the growth of the microbe disproportionately to that of the potato. The conditions need not necessarily be antagonistic to the potato; but if they help the microbe more than the plant, the microbe will gain the victory." In like manner it is with the human body — with its unfelt and unknown physiological conditions, and disease germs.

On the other hand,—as a little indiscretion sometimes weighs down the mortal end of life's balance, so a little extra effort in respect to the essentials of health —a little watchfulness, prudence, temperance, on behalf of our physical organism, easy enough to practise

after a determined endeavor and start, may bring down the other end—health, comfort and a prolonged and useful life.

After having obtained correct knowledge pertaining to the rules of health, then nearly all the requirements come within the range of two mental characteristics,—self-denial and resolution: self-denial, by which there is no further gratification of any one of the appetites or passions than is in accordance with the strictest temperance, in all things; resolution, by which there is no neglect of duty in this behalf, and regularity in the practices or habits of hygiene—out-door exercise, bathing, etc.

DIVISION OF THE SUBJECT.

All means or measures for the prevention of consumption may be considered under three heads: first, general measures by which the essentials of health—pure air, proper food, means of cleanliness, etc.—are provided for the entire population—for everybody; second, special means applicable to persons who have inherited or acquired a predisposition to the disease, who have the limited breathing capacity with the general well-known features, already enumerated, of the predisposition: third, means for preventing the formation of tubercle in persons who have already acquired the pretubercular condition and are on the verge of tuberculosis, commonly heretofore regarded as the commencing stage of the disease, with loss of the usual amount of energy and, perhaps, of appetite for food and of body weight. For the most part, the

preventive measures come within the scope of official health authorities as well as of individuals. Many of them, indeed, can only be provided and carried out practically and completely by united effort, as by state or municipality, and certain state preventive measures will, therefore, be considered.

First, we will consider in detail those essentials of health and life which should always be provided for the masses of the people. Although relating to general sanitation and hygiene (as these two terms are now used in a somewhat different sense, although both have in the original the same meaning), a good, practical, popular knowledge of such essentials is indispensable to the successful prevention of consumption: consequently they must receive attention in a work of this kind. All persons in any way predisposed to this disease, especially, should give them practical consideration, and, as far as possible, personal application.

CHAPTER XII.

GENERAL ESSENTIALS OF HEALTH.

PURE FRESH AIR FIRST.

Air may be regarded as the first essential of life in the higher animals, as pure air is that of health. The evil effects upon the human body of breathing impure air have been sufficiently dwelt upon in Part I.: the evils not only of air which has been overbreathed, especially, but of air rendered impure by other insanitary states—from foul gases, dust and damp air—and how such air interferes with the important function of respiration. Pure air is indispensable to a perfect respiratory function. For the most part, or so far as we are practically concerned, air impurities arise from man's own acts—overcrowding in dwellings and accumulations of waste products of life in and around them.

The soil upon which mankind live should be dry and clean, well drained, and kept free from all waste, decomposing substances on its surface, otherwise the surrounding air cannot be pure. Heavy, retentive, undrained soils are less salubrious than those which are dry. It would be well if there were some legislation for preventing the construction of dwellings upon damp soils, such as some towns are built upon,

until after thorough drainage. Marshes and swamps are naturally shunned.

THE BACK YARD as well as the front of all dwellings must be kept free from decomposing substances, excess of slops and the like. It should give growth to a crop of clean, healthful vegetation—fine grass, flowers, shrubs, and not foul, rank weeds. "Back yards," as commonly found and understood, should be entirely done away with; as also should the too common low parts, kitchen and sheds—the "tail" ends—of dwellings, which extend back into yards, and are rarely kept like the front parts, within or without. The back yard should be as nicely kept and as presentable as the front, or more so.

DWELLING-HOUSE conditions essential to health are so concisely pointed out by Doctor Thorne Thorne, in a paper on the Dwelling-house in Relation to Consumption (St. Barth. Hosp. Rep.), that I again take the liberty to quote his words, as follows: "1. A soil [for its foundation] which is dry (*a*) naturally; or (*b*) freed by artificial means from the injurious influence of dampness, and of the oscillations of the underlying subsoil water. 2. A dwelling-house so constructed as to be protected against dampness of site, foundations, and walls. 3. Such open space on at least two opposite sides of the dwelling-house as shall secure ample movement of air about it, together with its free exposure to the influence of sunlight. 4. Such construction of the dwelling-house as will secure for its habitable rooms and throughout its interior free movement of air by day and by night, and the free

access of daylight":—*i.e.*, means for good ventilation, with abundance of windows unobstructed by curtains. The necessity for perfect house drains and plumbing to prevent air poisoning need not be dwelt upon. The CELLAR as commonly constructed should be also abolished. Cellars should be as scrupulously clean, dry, well-lighted and ventilated as any other apartment.

THE BEDROOM, as a place where a third part of one's life is spent, is deserving of special construction and care. The small, close, badly lighted rooms in which some fairly well-to-do people sleep are a disgrace. Want of knowledge as to the requirements of health can alone account for such rooms. A bedroom, for even one person, should be large, well ventilated and exposed to sunlight. The dread many persons still have of keeping a window open even a little is also from ignorance on the subject. NIGHT AIR, so feared, is vastly better and less dangerous than the breathed air of nine-tenths of the bedrooms. A window open all night even in cold winter weather can do no possible harm if the bed, with abundance of clothing, be placed aside from any direct draught of cold air. In very cold weather and for feeble persons, provision must be made for changing the body clothing night and morning—for going to bed and getting up without chilliness or too great discomfort. Aside from this, the cooler the sleeping-room one is accustomed to the better. If necessary the bed may be first warmed, as by a bed-warmer. When in bed anyone can keep warm with plenty of clothing under and over the body.

TENEMENT HOUSES are not infrequently in a danger-

ous atmospheric condition. In selecting one, much care should be exercised ; and investigations made respecting its general construction—walls, drains—and the health of its previous occupants. Remember, the infections of consumption, as of other diseases, may adhere to inner walls. If any doubt, thorough cleansing and disinfecting would be the wise course. A brief record should be kept by health authorities of all tenement houses as relating to sickness and death in them for public reference.

Offices, shops, factories and schools should be closely looked to, even by those who are to occupy them, or by parents, as being most directly interested : particularly in respect to ventilation, drainage and any previous infection from the sputa of consumptives, or other disease. A recorded instance in which thirteen clerks, employed in an office in Paris, died of consumption in four years, attributed chiefly to infection from sputa, is mentioned in a previous page. Want of knowledge, carelessness and indifference, on the part of proprietors of working places, have sometimes given rise to most serious consequences. Proper official inspection of all enclosed places where even but a few persons are employed, and of schools, should be provided for.

Dust, as produced in certain manufactories, and even in many shops, or "stores," should be properly disposed of. Respiratory appliances for straining the dusty air, through cotton, wool, crape or feathers, at best, soon get clogged and are of little use. Free ventilation with fans and flues for aiding a strong out current are the best means for dust disposal.

VENTILATION : ITS IMPORTANCE, COST, ETC.

Pure air and ventilation are almost synonymous terms. We cannot have pure air in enclosed places without ventilation—change of air. After each breath—inspiration and expiration—there is a pause of a few moments before the next inspiration, as if to give the air just expired time to dissipate or be removed from near the person before the next inspiration. Out of doors, where there is always some motion of the air, change takes place readily. In closely enwalled places, if there be no means of ventilation, it is quite different. If a man go into an ordinary closed-up room, the air of which is as pure as outside air, in a few minutes, from the twenty-five or more cubic inches of foul, poisonous air he every three or four seconds empties into it from his lungs, the air is that much from being as pure as the air outside. How would it be if he remained in it an hour or two, or eight hours, without means for changing the air? or in case of a diseased man, in which the air is usually fouled more rapidly?

The physician advises his patients to "take fresh air," to "go out" or "keep out of doors." In many cases it is practically impossible for them to do so. Let them be advised, helped, shown how, to "take the fresh air"—the "out-doors," into their dwellings, much more freely than is now usual, with abundance of sunlight, too. This they can usually contrive to do when they cannot go out.

THE COST of ventilation, of constantly changing

warm breathed air for fresh, is the great obstacle. But it is much easier and better to pay for extra fuel than costs of sickness: better a fresh air bill than either a meat or a medicine bill. Householders and others should count on this as on any essential of life; and rather first of all: make it the first item in estimating living expenses,—extra fuel for warming *abundance* of fresh out-door air. If necessary, cut off some luxury, as of clothing, or even of meat, in part, or tea or coffee; but provide for pure air.

The methods of ventilation cannot be entered into at length here. The first principle, however, is to let out or draw off the breathed air to make room for the fresh. If a strong enough force or draught be employed to draw foul air out of a room, enough air will be forced in to take its place: but this may come from outside or from an adjoining room or house, it must be noted. An open grate fire provides excellent ventilation, especially if there be an opening, too, near the ceiling into the grate-chimney. In the absence of a grate, an opening, in size 3 or 4 by 5 or 6 inches, in the wall of a warmed chimney or even stovepipe, will draw off a great deal of the impure air of a room and give tolerable ventilation for two or three persons. With a high chimney it affects but little the draught or fire. The opening should be provided with a sliding door: and the hotter the fire or colder the weather the smaller may be the opening. Sometimes enough fresh air will then come in through the walls or cracks about doors and windows. If the walls are tight, with storm windows, weather strips and every

crevice tightly chinked, a special opening must be provided; as by raising a lower window-sash, closing the opening below and allowing air to enter between the sashes. When the outside air is very cold a very small opening may suffice. In warm weather windows and doors should be kept largely open night and day.

THE QUANTITY of fresh air which should enter a room or any enwalled air-space for each individual occupant has been estimated by the best authorities at a minimum of 3,000 cubic feet per hour, in health. In sickness, more is needed. With less than this, the air soon becomes manifestly impure: and with 10,000 cubic feet coming in per head per hour the air will not be as pure as that outside. The quantity should be limited only by the ability to bring it in without perceptible draught and to warm it sufficiently, and the greater it is the better. The larger the room or cubic space for each person, the easier it is to prevent draughts: and it is better to have the air warmed before it enters the room. To measure air precisely an air meter is required.

A FORMULA of Montgolfier teaches that, if the temperature of outside air be 32° F.—the freezing point, and that inside 64°—a difference of 32°—and if a chimney flue, with its contained "column of air," be 30 feet high, an area of the flue of half a square foot —72 inches—*i.e.*, a chimney flue of this size (say, 5x14 in.) would withdraw from a room about 12,000 cubic feet of air per hour: and of course the same quantity of fresh air would come in, in some way. The area of an ordinary stovepipe is only about half that, or

36 inches. If the outside air be at zero temperature, making a difference of 64° F. between it and the inside air, instead of 32°, twice as much air will flow out of and into the room. A fresh air inlet area of one square foot, say by means of a window sash three feet wide being raised four inches, in the clear, will permit the passage or entrance into a room of five cubic feet of air per second of time, or 18,000 cubic feet per hour, if it come in through the window opening at the rate of five feet per second: a rate about equal to the movement of a person walking $3\frac{1}{2}$ miles an hour. This rate would be distinctly perceptible as a draught at the point of entrance, but throughout the room it would not be half that rate: at ordinary temperatures, not usually felt. In the same circumstances a window two feet wide, raised the same height, would permit the inflow of 12,000 cubic feet of air per hour. These figures indicate but an approximation, in round numbers, of the requirements.

FLUSHING living, bed, nursing, school and other rooms at least once a day in cold weather is a good practice, however good the usual ventilation. When the room is warm, open all doors and windows: if there be a wind a very few minutes will usually suffice to materially change the air in it. Occupants may move about or withdraw from the room. After the room is closed the fresh air is quickly warmed by the warm interior of the room.

BREATHE FULL and deep. Much has been already written herein on the bad effects of shallow, imperfect breathing. Every person should habitually hold the

body erect, sitting or standing, and take full breaths. Many occupations have a tendency to cause stoop shoulders, which contracts the lungs and lessens the breathing capacity. By a little effort this tendency may be resisted. The stoop is a bad habit, objectionable in all cases, and in some persons may help much to give rise to a predisposition to consumption. Habitually full breathers do not take consumption.

THE NOSE is specially designed and constructed to be the only natural air passage to the lungs. If there be any obstruction in it to the free passage of air, as sometimes is the case in children, a physician should be consulted. It is dangerous to breathe habitually through the mouth. Most consumptives and scrofulous persons do so. By effort the habit may be overcome, even if it be largely from abnormal structure through heredity.

THE DIETARY: FOODS, COOKERY.

Well, *properly*, nourished persons, even animals, rarely become diseased. No narrow fixed rules of diet can with safety be laid down. Much depends on constitutional requirements and individual and ancestral habits. The digestion and other functions in each individual case must be consulted. Any change should be made gradually. A little experience and observation is usually sufficient, often essential, in selecting the most suitable diet, quantity required, etc.

THESE PRINCIPLES may be, however, laid down: in all cases the food should be abundantly nutritious (nature is everywhere and in everything abundant),

yet plain—unmixed, not compound—pure, and digestible. Rich, compound dishes, however nourishing, usually overtax the digestive and assimilative powers in efforts to extract their nutriment. Good bread, not fresh, of course, of whole wheat flour being in most cases best, milk and fruits, for children, and for older persons, some flesh meat and "vegetables" if desirable, constitute the best diet. Fried food, new bread, pastry—pies, cake and the like—and highly seasoned and mixed dishes, are neither digestible nor wholesome. Comparatively but little food will sustain life when one is at leisure, idle; much more being required when at steady hard work, mental or physical: more too in cold weather or a cold climate.

NEVER HURRY at meals, nor eat when over-fatigued or worried; unless it be but a little warm fluid food or a biscuit for refreshment. Starchy foods—potatoes, bread and fruits, should be thoroughly masticated into a soft pulp with saliva. This fluid aids much in the digestion of the starchy parts.

TO DRINK much at meals is not a good practice: but when from the nature of food or other cause there is a desire for liquids, one may *sip* them in moderation, when there is no food in the mouth. It is usually best to take the bulk of the fluids when the stomach is empty, as on getting up in the morning or on going to bed. It is, indeed, a good practice to drink a glass or two of water at such times, hot or cold. Many persons do not take enough water for the purposes of complete excretion—purification.

REGULARITY in times of eating is desirable. Any

physiological function is easier when performed with regularity. Hence the facility with which some habits are formed. The NUMBER of meals each day is of less importance than the total quantity eaten. Many meals tempt to overeating.

AVOID EXCESS OF FOOD. From long personal and other experience I have been surprised at the small quantity of food which will sustain an adult person in the best of health, especially when not engaged in hard work, and when it is thoroughly digested. The excess is liable not only to ferment in the stomach and bowels, and give rise to all sorts and conditions of local disturbances—" indigestion"—but probably also to poisonous substances—ptomaines, which readily circulate throughout the body and disturb and depress all its functions; while the excretory organs are overtaxed in efforts to dispose of or cast out the excess.

APPETITE—natural desire for food—the sensation of HUNGER, should be a safe guide as to the quantity required: but in most cases in the present age the natural appetite is so pampered from early childhood by over-seasoned or sweetened food, that it is not often safe to trust to it alone. The desire to gratify the sense of taste is mistaken for a demand for more food—for actual hunger. A careful distinction must be made here between the two desires: that to gratify the gustatory sense, and that to satisfy the needs of the body. Experience, with careful observation, eating slowly of only plain food and watching carefully for the first feeling of satisfaction as distinguished from satiety, will enable anyone to soon learn the quantity of food actually needed by the system.

Children often receive injustice from parents, all unwittingly, in being allowed to lay the foundation for future suffering and disease by indulging their unsophisticated appetites with foods too pleasing to the taste of the easily tempted little ones, commonly from excess of sugar. The welfare of all children is unquestionably best promoted by the use solely of the plain foods—bread, milk, fruits in season, fully ripe and sound, usually best raw, or not cooked with sugar. These, moreover, are usually highly relished and enjoyed by the little persons with no acquired appetite for other foods.

Cookery is most intimately associated with the nourishment of the body ; and bad cookery is responsible for much derangement of the body functions. It is impossible for anyone to be properly nourished on badly cooked food. The art of cooking should be generally and correctly taught, as in the schools or in special institutions. Radical reformers, who would make man again a non-cooking creature, may do good by denouncing the art of cooking in its present form. Raw beef, if pure and sound, is probably better than over, or badly cooked beef; and certainly good ripe seasonable fruits are better raw than when over-cooked in the usual way with sugar, forming the too common preserves and jams of most countries.

Tea, coffee, and alcoholic beverages, it need hardly be said, should be indulged in only in strict moderation, if at all, by everybody. The intemperate use of alcohol in any form lowers the vitality : and it does not take much imbibition of it to practically

constitute intemperance with this powerful stimulant. Many young girls, and mothers, too, use much more strong tea, less frequently coffee, than is consistent with health or digestion. Many great sufferers from over-indulgence in tea have come to my notice.

THE WATER AND MILK SUPPLY must be closely looked to, and spring, well, or other water kept free from any form of contamination. If its purity be doubted it should be boiled. The milk used must be pure and especially from healthy cows. If at all suspected, it should be sterilized by heat—a little below the boiling point (or 180° F.) will suffice.

GENERAL BATHING AND THE SKIN.

The bath to keep the skin clean and active is an essential of health which is not generally appreciated. The importance of the skin, with its probably two and a quarter millions of sweat glands (Huxley), as a vast emunctory, has been alluded to. The skin has been termed "the most important organ in the human economy" (Baruch). It performs a number of important functions: (1) that of a strong protective, sensitive covering to the inner organs; (2) that of touch; (3) that of excretion—casting out—of carbonic acid and urea (as it were, aiding the lungs and kidneys) besides other waste solids, with a large amount of water by which, as vapor, in the form of perspiration, it (4), most important of all, regulates the body temperature. Every clothed human being, in order to keep this great defender of the body in a healthy and sufficiently active condition, should take

a daily bath of some sort—a wash over the whole body surface with after friction: this not only in warm weather but in cold, when it is most needed. If such a practice could be made universal, the public health standard would be immensely increased.

Much that would be of interest could be written on the history of the bath and value of public bathing for public cleanliness. The difference between the facilities for, and practice of, general bathing amongst the peoples of the East, ancient and modern—Persians, Hindoos, Egyptians, Turks—when compared with those of Western Europe and America at the present time, is as remarkable as it is inexplicable. In Russia, whatever the sanitary defects, the use of the vapor bath for cleansing the skin, Doctor John Bell informs us (Treatise on Baths), "is general, from the Emperor to the poorest serf:" and in all northern Europe "there is no hut so destitute as not to possess its vapor bath." In Tokio, Japan, there are, it is said, eight hundred public baths (almost as many as Rome ever could boast of), and the poorest laborer there can have with facility the luxury of a daily thorough skin cleaning. The liberal use of soap and water, it is commonly said, is a great civilizer. Few persons, if any, will deny that, as Doctor Simon Baruch (Phys. Manhatt. Gen'l Hosp., N.Y.) words it, in a pamphlet, "A Plea for Public Baths," "Among the agencies which the experience of the human race in all ages has demonstrated to conduce to the preservation of health, *personal cleanliness* occupies the foremost position. . . . *Cleanliness, perfect, absolute cleanliness*." Without a clean, open-pored, flexible, active

skin, no one can be clean within; without inner (blood and tissue) cleanliness no one can be truly healthy. The eminent Hufeland said, "I regard cleanliness and cultivation of the skin as the chief means for prolonging life."

How is it in these very countries we regard as the most civilized? The great body of the people are here commonly characterized, by the comparatively few who do habitually wash the body surface, usually in cold water only, as the "great unwashed!" While cultivating one special feature of Christian civilization—charity, have not Christians been guilty of neglecting a common duty which was intended by the great Founder of that civilization should not be neglected — personal cleanliness by more frequent washing? By making baptism (Greek, *Baptisma: baptieu*, to dip in water) the first manifest emblem of Christianity, it could not have been intended that the then common practice of bathing amongst Jews, as well as Greeks and Egyptians whose priests bathed two or three times a day, should be in any way or degree neglected or superseded by that "charity," now so conspicuous in the provision of almost every want for the masses of the people except facilities for ordinary reasonable personal cleanliness—for keeping clean the living "temple of God" (St. Paul).

The value of public bathing has been clearly demonstrated, practically, in Germany, where in recent years a system of warm shower or rain baths has been introduced into certain schools and barracks for washing the pupils and soldiers. Amongst these

persons, so bathed, there has been, as a consequence, a marked improvement in health, vigor and intellectual power, with a reduced mortality. The Director of one of these schools in Weimar reports that, although at first but few pupils were disposed to take the bath, after two months, 75 per cent. of them took it daily, and "the freshness and pleasure for study after the bath, the cultivation of a desire for cleanliness and the promotion of health, offer such decided results that I cannot refrain from recommending" the system to other schools. Certain manufacturers there have provided their employees with facilities for bathing, and the improved health and more efficient service of the employees give a good return for the outlay incurred. At a health congress a few years ago in Hastings, Eng., Sir Edwin Chadwick said, "The German army was the lowest death-rated of any in Europe" (5 per 1,000 men: England, 8; France, 10; Italy, 11, per 1,000). "One means of this was the factor of washing with tepid water. That, he had shown, in England, was the great means of reduction of the children's diseases in the district schools. In Germany half a million soldiers were being washed with tepid water at the cost of about 6d. a hundred, soap included. He expected to be able to display a power of washing children with tepid water at the rate of . . . one penny for a dozen" (3 minutes for each pupil at each jet or bath). "He had long ago shown that washed pigs put on one-fifth more flesh than the unwashed, and more than this was the result with children" (Brit. Med. Jr.),

Shower baths by sprinkling jets can be provided at less cost than immersion baths, and the cleaning effects are better: each bather while rubbing his body being under a continuous sprinkle of fresh water. In the New York Juvenile Asylum, 280 are washed per hour, each with fresh tepid water.

Until special provision for more general bathing be provided, there is no one who could not at least wash all over the surface of the body every day with the warm hands dipped often in water, just as the face is commonly washed. This constitutes an easy, refreshing, invigorating bath. An occasional warm water or vapor bath for "opening"—cleaning out, the pores of the skin is necessary, especially for persons who do not perspire freely; for those exposed to dust a good wash with soap should be taken more than occasionally.

THE INNER BATH, to wash out the tissues, is as essential as the surface bath. Said Doctor T. Lauder Brunton, F.R.C.P., etc. (Phys. St. Barth. Hosp.: in Cavendish lect., 1895), "Water is not only useful to wash out our closets and flush our drains; it has a similar effect in our bodies, and tends to wash away the waste products from the cells of which our organs are composed, to clear out the uric acid, urea and phosphates through our kidneys, . . . and to wash out our liver, especially an organ which suffers much from want of water." For the most part, the improved health resulting from a sojourn at various "springs," he, with other high authorities, contends is from "an abundant supply of water" in the body rather than from any "medicinal" ingredient in the water.

SOME OTHER ESSENTIALS.

The clothing should be such as to prevent chilliness or a feeling of coldness: but on the other hand, not such as to create sensible perspiration. When out of doors, one in fair health should keep warm rather by exercise than by the clothing: reserving heavy or thick overcoats and mufflers for the coldest days or for driving in. Woollen is probably best to wear next the skin at all seasons. It need not be worn in bed. The garment worn next the skin during the day should never be worn in bed. The oftener the underclothing is changed, and either washed or well shaken and exposed to the air and sun, the cleaner, and better the action of, the skin. As to the quantity of clothing necessary, habit and use have, as in everything else, much influence. One may by wearing much, soon seem to require much, or on the other hand, habituate themselves gradually to comparatively little.

Of exercise (physical) the great majority of persons get enough; many too much: many, particularly women and young children, not enough out of doors. Large numbers of young men do themselves harm by engaging too freely in the more active games. Although exercise is highly extolled and recommended, probably the benefit of out-door exercise is often much more from the out-door part—purer air and sunlight, than from the exercise in itself. A certain amount is an essential of life: and all the muscles must be brought into daily use or they will lose their actual

structure and become soft and weak. Then their action—their repeated shortening and swelling out, in producing motion, greatly promotes the circulation of the blood, and also of the lymph. Lymph, it should perhaps be stated here, for non-medical readers, is a thin watery fluid which circulates in very minute delicate vessels, called lymphatics, about as freely as does the blood. It seems to be a sort of auxiliary to the latter in both nutrition and secretion, with an intermediary function between the blood and true tissue structures; a kind of "go-between." The lymphatic glands exist along the course of these vessels, and are very liable to become the seat of tubercle bacilli. Exercise is therefore a necessary agent in both nutrition and the elimination of waste. It also promotes respiration, digestion and sleep. A good many persons—students, writers, sewing girls—do not get enough active exercise to keep the breathing function up to the health standard—the "breath good," and the muscles fairly firm. The remedy is obvious, and must not be neglected if health and life are valued. Athletism is the other extreme.

OVERWORK, on the other hand, is frequently a strong factor in causing consumption. Some men and many wives and mothers drudge their life away, joylessly, the latter usually at in-door household work, probably baby-nursing, striving to "make ends meet" or perhaps with the unwise object of saving money. Consumption is more likely than any other disease to be the consequence of the exhaustion and depression caused by such a life. What physician after a few

years of practice cannot recall the death from this disease of a mother, caused, remotely but largely, by household drudgery while suckling an infant? Men who overwork do so usually in the open air, and serious consequences follow less frequently. Rest more, busy, active wives and mothers: rest. Lie down, and calm and rest the mind, too, two or three hours every day. Let the least important work go undone.

SLEEP checks and moderates, at fixed periods, the incessant and perpetual stream of vital consumption: said, a hundred years ago, that distinguished philosophic physician, Hufeland. From sleep we "obtain the happiness of being daily re-born;" of "passing every morning into a new and refreshed life." The importance of getting sufficient sleep need not be dwelt upon. Probably no one can do well with less than six hours, or needs more than eight. The best hypnotic is a judicious combination of a contented, unworried mind, a body free from symptoms of indigestion, slightly fatigued, and a comfortable bed in a quiet, well-ventilated room.

SUNLIGHT is another essential of health, which is not commonly prized as it should be. A large proportion of men and boys get it freely out of doors, but many women, young girls and little children suffer for want of it. Husbands and parents should see that their wives and little ones get more out-in-the-sun recreation, and more sunlight in-doors by means of uncurtained windows.

AVOID EXCESS in everything, we must, if we would preserve even a fair degree of health and vigor.

Intemperance of *any* kind, soon in some cases, later in others, depresses the vitality of the whole organism, and predisposes to consumption.

THE EXCRETORY FUNCTIONS must be kept in order. Usually they will not require more than attention to the general instructions herein. Constipation of the bowels, however, must be prevented or removed, as by the coarser foods or mildest laxatives, with regular "habit." The kidney excretion, if not free and clear, may require more water drinking; and the skin, occasional exercise, to cause free perspiration,—or a warm or rather hot bath.

ALL INFECTIONS should be by all persons, particularly children, carefully avoided. It may not be too utopian to hope the time will come when from more perfect public sanitation and personal hygiene, infections will be practically eradicated. Meantime, the infected should be kept isolated.

CONCLUDING PRECEPTS: make no sudden changes, but gradual changes, in established habits and uses. Never neglect a "cold on the lungs," but if it be not "going off" in a week or so, apply to a physician. In convalescence, or when not very well, exercise extra care in avoiding infections. Do not marry a consumptive, or not until she, or he, is free from marked predisposition. Avoid night vigils: the depressing weed, tobacco; mental worry or depression; and endeavor to keep on the peaceful side of all mankind.

CHAPTER XIII.

SPECIAL INDIVIDUAL PREVENTIVE MEASURES.

WE have now considered in sufficient detail the general essentials of health, applicable individually to the entire population, for the prevention of disease generally, or of body derangement of any kind, and consequently of the development of a predisposition to consumption. It is safe to say that if the instructions given in the previous chapter were fairly and practically carried out by everybody, few if any such predispositions would ever develop. Lamentably few, however, of those who know the rules of health follow them even fairly well, or not until the discomforts or pains of a deranged or diseased body awaken them to a realization of the fact, that in order to keep fairly healthy it is necessary to be guided in our habits of life, not altogether by our more or less morbid or sophisticated desires or inclinations, but rather by certain reasonable health rules or laws: laws for the most part made known long ago, by inspiration to man by his Creator, through the great law dispenser, Moses, the transgression of which inevitably brings, soon or later, in some form, the punishment—the consequences of "sin." Then, indeed,

the pound of cure is sought for. We shall have, therefore, for a long time to come, numerous persons developing a fitting soil for the tubercular seed ; while at the present time there are thousands with soil already fitted. Let us next, then, consider some special measures for preventing the development of the disease in persons who possess, in a greater or less degree, either from inheritance or habits of life, the predisposition to it, as already described.

In Part I. of this book the nature and importance of respiration was explained, and the manner in which imperfect performance of this function seems to give rise to a predisposition to consumption. It was also explained, how the lungs perform a double function—that of supply (of oxygen) and that of elimination (of waste), or excretion : how they expose to the atmospheric air within them the blood which had just circulated throughout the body, and allow it to get its load of oxygen and discharge its load of carbonic acid and watery and other vapors : how that when the lung membrane is contracted or thickened and not as active as it should be, sufficient oxygen is not taken into the body, and waste matters are not cast out but accumulate in the blood and tissues : and that there, eventually, in their decomposition, they probably give rise to certain inorganic substances—food for saprophytic, vegetative micro-organisms such as the tubercle bacillus—and also, to some special organic toxic compound (or compounds), by which in some way non-virulent bacilli are transformed into pathogenic or disease germs, which then constitute an essential

factor in the production of tubercle and causation of consumption. In brief, it seems highly probable, as it was my endeavor there to demonstrate, that a certain condition of body produced by the decomposition of accumulated waste in the blood and tissues consequent upon defective breathing, is also an essential factor, indeed, practically, the immediate exciting cause, of consumption: and that all other causes, excepting the bacillus, are rather secondary or remote, and for the most part only help to produce the defect in respiration. For example: all depressing, debilitating habits, as in respect to diet, exercise (or want of it), etc.; debilitated or deranged conditions, as in rickets and measles; also, lung adhesions from pleurisy; and still more directly, dust and other air impurities, more especially those from the breath, all contribute to limit or obstruct the breathing function.

There are many bad breathers; many persons who do not breathe enough air; who from proportionately small lungs from heredity, or from habitual shallow breathing with originally well-developed lungs, often influenced by occupation, perhaps by close study at school, do not take into the lungs enough air and oxygen, and consequently do not throw off the waste excremental matter which should be thrown off by the lungs. The system then eventually becomes poisoned by its own tissue refuse, the dead waste of imperfect tissue metabolism, or wear, or the toxic products of the decomposition of this waste. Furthermore, full breathing is essential to the free circulation of the blood and lymph, and hence also to complete

nutrition; and so shallow breathing contributes in this way, too, to the general bodily derangement. As Professor Roberts (Boston) says, "As a man breathes so he lives. To half breathe is to only half live."

Now, whether any special bacterial food or transforming toxine be produced or not in persons with a defective respiratory function, it is from *imperfect breathers* that consumption selects its victims; if not actually in every instance, practically so. These are the persons who provide the "good soil" for the seed; these are they who take the disease.

No physician now undertakes to treat or cure the disease, however early the stage, even in the pretubercular condition, without first of all making efforts to improve the respiratory function,—to increase the intake of oxygen and consequently output of tissue waste, by at least insisting on the use of the "pure air" or "out-door" remedy, or an out-door life. Usually physicians go still further in this way, and recommend all such patients to breathe deeply and freely of the pure out-door air, and perhaps with some special chest exercises; or as in some cases, the pneumatic chamber is employed, or it may be, the inhalation of oxygen is recommended.

Defective respiration is never alone, it need hardly be said, never the only cause of the predisposition. It never works up the special body condition—the fit soil, by itself. Helping it on are usually impure air, improper food, depressing habits and other assistants.

The remedy in such cases is simple, chiefly to improve the breathing function. It is comparatively

easy to habitually increase the amount of air breathed, as already stated, whether the defect be hereditary or acquired. Especially is it easy in young persons. Even in persons advanced in years, and those in the early stages of consumption, the breathing capacity may be considerably augmented. While improving respiration, other conjoined causes must be removed. Pure air must be breathed, night and day; the food must be made as suitable as possible; the skin especially must be attended to, and so on.

Usually there is no difficulty in any person recognizing the imperfect breather after attention is once drawn to him, or to her, by the failure in general health or vigor; or in case of hereditary defect, by the general delicate or puny constitution, as explained in a previous chapter.

GENERAL RESPIRATORY EXERCISE.

Persons predisposed to consumption particularly require general exercise, because of the increase in the circulation of both blood and lymph which it causes, and the consequent elimination of waste from the body. But exercise demands force, and force, digested food: and the strongly predisposed are therefore often not able to take much exercise. Hence the necessity and value in the worst cases and in the earlier stages of the tubercular state of passive exercises—massage and "Swedish movements"—given by another person, without effort by the affected person. It is necessary then for the predisposed to take exercise only proportionate to the constitutional ability,

and without exhaustion; to which point the exercise should never be carried, nor even to great, only to slight, fatigue. This is important. It is safer to err on the side of too little. Those exercises which tend more particularly to expand the chest and lungs are to be recommended.

ERECT POSTURE of body, sitting, standing and walking, with the shoulders and head set well back, as in the following figures, 1 and 3 (from Checkley),

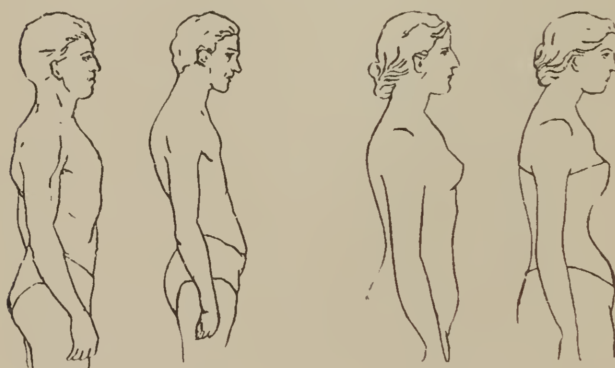

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

is particularly desirable. A stoop is very commonly a precursor, indeed a cause, of contracted lungs, and must be promptly and completely counteracted. By taking the correct posture whenever it can be thought of, most persons will soon, when strongly impressed with the importance of it, acquire a habit of keeping the body erect. At first it may be tiresome, but by use the muscles become stronger and the upright

habit unconsciously sustained. Children disposed to stoop should be encouraged to keep erect by being frequently reminded of it. Occasionally shoulder straps or supports are necessary; but I have very rarely found it so. When used they should be left off when the upright habit is acquired.

Walking increases largely the respiratory function. Running produces a more marked effect: and walking up hill a still more. Hence tennis, golf, cricket and even baseball are useful exercises. Boxing and quoits are also good. Football and lacrosse are liable to be too violent. Rowing, if it do not excite too much the heart's action, is good; paddling still better; so with the more prosaic wood sawing or chopping. In the latter it is better to have the log or stick raised up, as on a special "saw horse." When bicycles are so constructed that the rider is required to sit up erect, bicycling may be indulged in. Horseback riding has been extolled perhaps more than anything as a mild exercise for consumptives. It is best to sit firmly on the saddle with the body and arms in full play with the trotting horse. When one walks the arms should swing freely. Any exercise which greatly increases the heart's action, as to "palpitation," should be avoided. In all cases avoid dust as much as possible.

SPECIAL LUNG EXERCISES.

A variety of exercises or so-called lung gymnastics have been recommended by different physicians for increasing the lung surface and function. Some of

these require certain appliances, as dumb-bells, chest weights, etc.; others are simple or "free." The use of most appliances requires the expenditure of more force than do free exercises. The object is to increase the respiratory capacity—the size of the chest and lungs—first of all, and with the least expenditure of force. Free exercises are therefore usually best for non-vigorous persons.

To simply increase the breathing capacity, in cases with no lung disease, it has been my practice during the last quarter of a century to recommend the following free exercise, which has proved quite satisfactory: In pure air, out-doors when possible, standing in a correct position, slowly carry the hands from the sides to meet above the head, well back, and at the *same time* draw in air *slowly* until the whole trunk is fully distended; then while slowly bringing the hands down again let the air out slowly until the trunk is compressed as much as possible. Breathe two or three times in the ordinary way and repeat the act. This do five to ten times; and three or four times a day or oftener go through a like exercise.

After a little practice endeavor in the acts to distend the chest as much as possible without straining effort; hence slowly. Should slight dizziness occur at any time, as it may at first with very full distension, it will soon pass away. In beginning, some young persons experience difficulty, usually from haste in the attempts. A little time and patience will give success, in this as well as in the more complicated vigorous exercises to be presently described.

Besides increasing the chest capacity, it is desirable to strengthen the chest muscles that the increase may be permanent. For this, the six formulas below (chiefly from Denison, as cited) answer every purpose. The forms should be practised in the order given: the first, milder ones for a time, and then the next, and so on, reaching the more vigorous perhaps only after months of practice. Each act, as directed in each form, is to be repeated three or four to ten times in succession on each occasion,—few times at first, more after practice, and one, two or three times a day. And one should always go through them deliberately, not hurriedly. The latter, more severe ones are not indispensable, remember, to good health; but when rather a pleasure than a cause of weariness or discomfort, they usually give greater vigor and resisting power.

The time, place and dress for the exercises are of importance. An hour or two before or after a meal is the best time. They should always be taken out in the pure open air, if at all practicable; if not, in an open shed or large, cool, light, airy room. The clothing must all be so loose as to permit the freest possible movements. This is an indispensable condition. Corsets must of course be left off, especially while exercising, and be worn very loose at all other times.

Persons of strongly marked predisposition, and especially after any blood spitting, must be careful in the beginning in even the mildest form, that already described: and of course, in such cases, under the guidance of a physician. All the forms are perfectly safe at any stage when gradually, carefully and

moderately practised, only mildly at first, with but few repetitions.

Besides the special forms, or to begin with, it is well to practise striking the arms out forward, as in boxing, and sideways, too, with a degree of vigor proportioned to the strength, and for a very short or a longer time, always breathing deeply.

In all cases or exercises start with, and pause in, the correct posture or attitude of body.

1. Stretch the arms out, from the side, to the front, horizontal, then slowly draw the elbows back, close to and past the sides, as far as possible, and take a long deep breath at the same time, and repeat.

2. Slowly raise the arms to front horizontal while taking a deep inspiration: then hold the breath while the largest possible circle is made with each hand, both at the same time, upward and backward, above the head, and around to the sides again.

3. While settling down on the toes, as represented in Fig. 5, make a forced expiration; then while rising slowly to full height take a full inspiration, and at the same time move the hands in a circle, downward, backward and upward, somewhat as in swimming, with the arms stiff.

4. While extending arms directly forward to horizontal take a deep breath; then without moving the face or feet, move right arm and chest around toward left as far as possible, keep left knee stiff, bend right one and touch the floor with fingers, expiring while returning to correct standing attitude: next, take another deep breath while raising arms again to front

horizontal, and then turn left arm and chest to the right, bending left knee while touching the floor.

5. Extend the arms to side horizontal and walk thus into a corner of a room, as in Fig. 6, and while there take from three to ten full inspirations: by

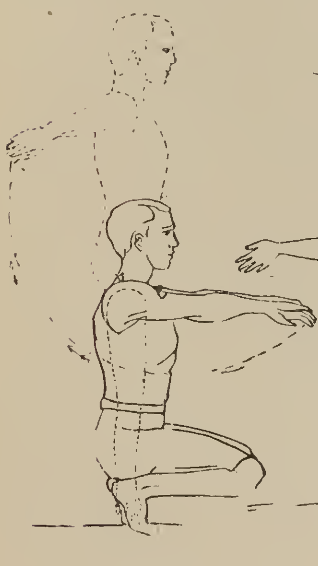

Fig. 5.

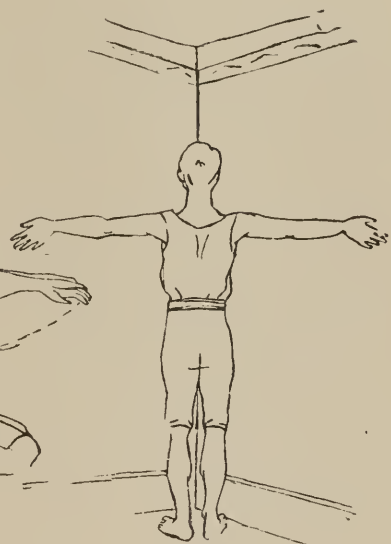

Fig. 6.

practice from day to day gradually get a little farther and farther into the corner.

6. Place two chairs about twenty inches apart, and with the body straight and stiff, rest on the toes and hands,—Fig. 7: settle down between the chairs and take a few deep inspirations and then raise the body to the height of the extended arms.

17

Remember the instructions given in the three or four paragraphs immediately preceding these formulas: commencing gradually with the first and simplest exercises, etc.

HOW TO KEEP OUT OF DOORS.

It has been stated that the benefits of an out-door life are more from the pure air and sunlight than from exercise. It is commonly believed that in cold weather one cannot be out much without exercising

Fig. 7.

a good deal or working, in order to keep warm, or unless well wrapped in a carriage or sleigh. This is a serious mistake. By putting on sufficient clothing one may sit or lie down out-doors when the thermometer is below the freezing point. I have persuaded patients to sit outside most of the day, and with a camp-cot or lounge, to occasionally lie down, with heavy under-flannels and two or three coats on, in freezing, December weather, with great benefit. Women may contrive to dress equally warm. On any approach to a feeling of coolness, and before chilli-

ness, a little walking about or arm-swinging is necessary. When one is so circumstanced as to be able to drive, of course it is pleasanter: but there is no reason why one may not keep as warm sitting on a comfortable chair or lying quietly on a lounge out in the sunshine in severe weather, as in an easy open carriage or sleigh moving about, except it be in the diversion of the mind by the little change of scene in driving. One can be "bundled up" just as well on the chair or lounge; and read much better. In this way invalids may safely remain out much more than seems possible to many persons. The feet and hands should be well protected. The chief point is to put on abundance of clothing on every part of the body. Wraps and quilts may be used. Always exercise care that the breathing be not in any way or degree impeded by the clothing; and keep up deep breathing.

OCCUPATION CONSIDERED.

Choice of occupation for the prevention of consumption is a subject perhaps next in importance to that of provision for breathing abundance of pure air; for it closely concerns or bears upon the facility or possibility of a perfect respiratory function. All persons at all predisposed to this disease should therefore give it special consideration. Besides too constant confinement in-doors, there are two ways in particular in which occupation may even give rise to the predisposition: namely, first, by necessitating more or less strongly certain body positions which cramp the chest and prevent habitual full and free expansion of

the lungs; and second, by giving rise to excess of dust in the atmosphere. Persons working in a dusty atmosphere, too, naturally avoid deep breathing.

The influence of occupation upon health and especially as predisposing to consumption has been long recognized. Over a third of a century ago, Doctor Greenhow, a practical sanitarian, in England, drew attention to the enormous mortality from this disease in England and Wales, chiefly from the effects of dusty occupations. The death rate was particularly high amongst potters, grinders, filemakers, printers, masons, wool and cotton manufacturers and others working in dust: also amongst tailors, dry-goods clerks, grocers, bakers, carpenters and dressmakers. In 1860, the medical officer of the Privy Council reported that. "In proportion as the male and female populations are severally attracted to in-door branches of industry, in such proportion, other things being equal, their respective death rates by lung disease (phthisis) is increased." Since that time a great reduction in the mortality has been effected, as by wet grinding and free ventilation. Much yet remains to be done, however, on this continent, as well as elsewhere.

A practical illustration of the effects of occupation on the consumptive has been recorded by Doctor Herman Weber (Croonian lect., 1885). Although it has been many times published, it will be well to quote it here as briefly as possible. A teacher and his wife both died of consumption under Doctor Weber's care. They had had seven children, the second one of whom had died young of tuberculosis

of the brain membranes. At the mother's death, four boys, of twelve, nine, seven and two years of age, and two girls, of five and one, respectively, were living and fairly healthy, except the youngest boy who had rickets. Of eleven cousins of these children, nine died of consumption before the twenty-eighth year of their life. The prospects of the six orphans looked gloomy. They were sent to the country—a mountainous district in Silesia, and brought up with much care under Doctor Weber's instructions. The eldest, up to the age of twenty-three, so long as he lived mostly out of doors, with probably hill climbing, was well and strong. "He then became a hard student, working night and day, having his meals in his rooms, and taking very little exercise. In eighteen months afterwards he died of rapid consumption. The second son was a farmer, and remained healthy until his twenty-ninth year. He then became tired of the monotony of country life and went into a mercantile house, where he was engaged for many hours each day in an office. He worked hard at his books in his own room during the evenings. After two years he had repeated hæmorrhages, and in two years more he died of tuberculosis." The third son became a cavalry soldier, lived judiciously and remained healthy and strong. The youngest son, who had been rachitic, was a healthy farmer in Manitoba a year or two ago; and his younger sister, a healthy girl, was keeping house for him. The elder daughter married a country clergyman and remained quite healthy.

The history of this family, Doctor Weber remarks,

"shows that by favorable circumstances, even a strongly marked family tendency may be neutralized. . . . It further teaches the serious lesson, that if the stringent rules of health are neglected, even after the constitution has become satisfactorily developed, the disease may suddenly show itself and run a rapid course," to a fatal termination.

In selecting an occupation for one predisposed to consumption, many points must be considered and weighed. All such as are sedentary and requiring much time in-doors should be avoided. It is not sufficient to be out for a few hours each day. Any occupation which gives rise to dust, or which requires an unusually high temperature, as in overheated rooms, or a stooping posture, is highly objectionable. The occupation should not be laborious: though as much general activity as the constitutional strength will well bear is desirable." "Travelling" (commercial) on account of the irregularities of such a life is not usually suitable. Then, in order that the occupation may be agreeable and of interest, so that success in it is likely to follow, a selection in this behalf must be made. All this narrows down the choice. Again, life in a city, chiefly from the air being less pure, is less healthful than in the country, or small country town. The city, too, provides a smaller proportion of out-door occupations.

AGRICULTURE in some one of its forms, with some precautions to be named, is probably of all occupations on the whole the most salubrious; although a seafaring life may be in some cases preferable. Stock or

poultry raising, fruit growing or gardening may easily be made a sufficiently light or easy employment. Certain objectionable features in ordinary farm life require to be removed in order to obtain the full advantages of the work. For example, during the colder season in northern latitudes there is often too much in-door life; and worst of all, in unventilated, overheated rooms. The bedrooms, too, are usually small and unventilated. Some of the work gives a strong inclination to a stooping posture, and sometimes there is a dusty atmosphere. Farm-houses and their surroundings are commonly in a more insanitary condition than city houses. These objectionable features may be in a large measure or entirely, and easily, removed. Carpenter work and brick or stone laying out of doors should not be much more unhealthy than work on a farm.

Of the learned professions, it appears that the average life of clergymen is the longest, and that of law the next. From the medical knowledge of physicians they should live the longest, even subject as they are to exposures and irregularities. In country practice, especially if not made too laborious, it should be, as indeed it not infrequently is, promotive of health and longevity. The time of study required for a profession is an objection; yet with due care this may be overcome by persons not of a strongly phthisical family history. A few persons study medicine chiefly in the interests of their own health—for the medical knowledge it necessitates. Surveying and engineering are healthy occupations.

For women, suitable healthy employments are still more difficult to select. There is no reason why many more women should not engage in the lighter forms of gardening and flower growing, and in poultry raising. A few have done so with success. A large majority are practically forced to household work with the care of young children. Such work is, however, sufficiently active and varied, and need not be made over laborious. If all rooms were well ventilated and lighted and kept at a proper temperature—if the air within were kept as pure as it might easily enough be, if the "out-doors" could be much more freely brought in, housework would be one of the most healthy of employments. This want of pure air prevails to an equal, sometimes greater, extent in almost all other occupations for females. In teaching, in office employment, in shops, dressmaking, millinery, factory work, there is a like want of pure air. Women, as suggested in the case of men, should enter protests against the impure air and dust they are now in many cases practically forced to breathe. Husbands should more deeply consider the necessity for pure air for their wives engaged in housework.

DIGESTIVE AND NUTRIENT FOODS.

Next to a supply of pure air and good respiratory action is nutrition through the stomach. Hence the diet must be specially considered. Doctor W. H. Porter goes so far as to say (at N.Y. Acad. of Med.) that "Far the most could be done in eradicating tuberculosis by feeding properly from infancy up."

The digestion in many cases when the predisposition is marked is poor, insufficient for good nutrition. Out-door exercise will improve it, often sufficiently. Horseback riding, jogging, is usually particularly good in these cases. Exercises which bring into action the muscles of the trunk are also good. It may be necessary to resort to massage. It is very desirable to keep the bowels regular.

Simple nutritious food, well cooked, must in all cases be provided. The best authorities would give, as a rule, only a moderate allowance of animal food. I have seen a decided phthisical predisposition in young persons practically eradicated on a diet of milk, bread and fruits, largely of fruits, especially apples. By most authorities such a diet is recommended as best for young children. Why not for older persons? Von Ziemssen says, "The 'grape cure' and the 'whey cure' conjoined with mountain air,"—doubtless any pure invigorating air, "are excellent." If such food be excellent for the cure, surely it would be also good in removing the predisposition. In the case of some persons, from a diet largely of fruit, enough nourishment seemingly cannot be extracted. The addition of plenty of milk and bread usually makes it sufficiently complete.

Special foods are not often required except in the more strongly predisposed—in the pretubercular condition—a part of the subject which will be explained further on. The supply of good rich milk when it can be digested and assimilated, or of the lean of meat, beef being best, may be increased if it seem

desirable, as in some cases it will. Occasionally minced or scraped beef or beef juice is necessary; or, it may be, predigested food—peptonoids or beef meal.

Fats seem to be often indicated, but little being habitually taken in a number of these cases: hence the use of cod liver oil: a fat, from its nature or source, usually easily assimilated. Sometimes cream is better, more acceptable to the stomach.

PREVENTING "COLDS": THE COLD BATH.

A "cold on the lungs" frequently gives rise to a condition favorable to the development of consumption. Persons of a consumptive family being more than usually liable to such colds, it is most desirable that every precaution be exercised to prevent the colds. With this, a little of the "hardening" process is good, to lessen the susceptibility to sudden changes of temperature. Of all measures for this purpose, that of keeping the skin active and vigorous by the daily cool or cold bath is best. The practice of habitual bathing has already been highly commended for everybody, and all persons disposed to take a cold easily are particularly urged to adopt it, and in as cold a form as each individual constitution will well bear; on account of the tonic effects. Personal experience, since early life, and observation of its good effects in the many cases in which I have enjoined it on patients in a practice of over a quarter of a century, warrant me in strongly recommending it.

The simplest form of cold bath, and which in nearly all cases is quite sufficient for susceptible non-

vigorous persons, is that of a wash over the whole body with the warm hands repeatedly wet in cold water just as most persons wash the face. The bather may stand on a square of oilcloth with a piece of carpet under the feet. Almost any person, even the least vigorous, can take this bath, and in two or three minutes, with but a pint or two of water. A sponge or cloth may be used, but the hands being warmer,—and, if necessary, they may be first well warmed—feel less uncomfortable to the beginner. The room for most persons, particularly at first, should be comfortably warm; and the quick wash should be followed by sufficient brisk rubbing with a dry, rather coarse towel to secure good after-reaction—a warm, smooth, glossy skin with a feeling of comfort and invigoration. A soft towel, as absorbing better the water from the skin, may be used for the drying, and a coarser one for the after friction.

On commencing the practice, or if reaction be not good—warmth and comfort do not at once follow, a part only of the body, as the chest, may be exposed and washed at the one time and another part later, directly after or otherwise. At first, too, the water may be tepid, and gradually used colder and colder from time to time. Delicate persons who never could take a full bath by immersion, even slowly, in water only a few degrees colder than the skin, without much gasping from the mild shock of immersion, and after discomfort from want of good reaction, have been, to my personal knowledge, able to take this hand bath without discomfort, indeed with

refreshing invigoration and the best of after results, especially in exemption from colds. And it has surprised me to find how readily some non-vigorous persons become able to take the bath in quite a cold, almost frosty room. Feeble persons on beginning may require help in order to take even a partial bath quickly enough: the quick action of washing and drying producing undue excitement. No rashness must be attempted; cold is a powerful remedy. A little time and care are sufficient to secure success. Some more vigorous persons are more benefited by a shower or rain bath, as being, when borne, still more invigorating. Do not be ambitious to use water too cold,—rather comfortably cold, with the body warm.

The preferable time for the bath is on rising warm from the bed in the morning. It may be taken just before going to bed, or at any time three or four hours after, and an hour before, a meal.

Ziemssen remarks on this subject,—" I cannot conclude this chapter on prophylaxis without referring to hydrotherapy, which occupies a very important position both for the prevention and cure of tuberculosis. Winternitz, to whom principally we owe scientific hydrotherapy, has published his experience relating to its use in this disease in a brief essay, entitled 'Studies of the Pathology and Hydrotherapy of Pulmonary Phthisis,' which I strongly recommend. My experience of the 'hardening' method, where there is an hereditary or acquired disposition, agrees fully with his. Water at suitable temperature is the best, simplest, most available agent for strengthening

and 'hardening' a weak body or one disposed to catarrhs and colds. Even a simple rubbing down of the entire body with a large moist cloth, after getting up in the morning, accustoms the skin to sudden cooling off. . . . The practice drills the vaso-motor nerves of the peripheral arteries to prompt reaction. It acts on the respiratory, circulatory and digestive systems. At first, water of about 86° F. is to be used, and the cloth should be well wrung out. On each succeeding morning the temperature of the water may be reduced one-eighth of a degree."

In weak constitutions where appetite and assimilation are poor, Ziemssen recommends that common salt be added to the water in considerable quantity. Should a more thorough treatment be desirable, Ziemssen continues, "the patient may be sent to a water cure" (or hydrotherapeutic) establishment: "necessary in persons deficient in will power." "This simple procedure overcomes sensitiveness to changes of temperature, wind and dampness, and renders excessive clothing unnecessary. It overcomes constant slight perspiration, nasal and bronchial catarrhs, rheumatic disposition, etc., and gives to the body freshness and elasticity."

For a healthy, vigorous skin, as already stated, its absolute cleanliness is indispensable, and, for most persons, a more thorough wash should be taken weekly or from time to time. Soap is but rarely necessary, except at the beginning or for persons engaged in a dirty occupation. Soft water with friction is usually sufficient. For persons with thick, coarse skin, or

almost any person, an occasional hot-water or vapor bath for cleansing and opening the pores is desirable; and usually it is invigorating to pour a little cool or cold water over the whole body immediately thereafter. And a weekly hot foot bath with cold water poured over the feet immediately after, is good for keeping the skin of the feet active and less susceptible to cold and dampness.

The clothing in its relation to the skin—its changes, airing, etc., has been already sufficiently treated (page 243); except that non-vigorous persons usually require a little extra clothing; not so much on the body or chest as on the extremities, even to the hands and feet. Wear enough on the feet especially to keep them *always* comfortably warm. In cold weather one pair of stockings is not usually enough. Rubber should be worn only on the bottom of the feet—the soles.

DRAUGHTS, even very moderate currents of air, strike too much terror into a large number of persons. Strong cold draughts are not good. From this the fear some persons entertain of mild currents has doubtless arisen. For the most part, any after aches or pains, or the little "cold" somewhere which many experience after exposure to a mild draught, arise from so carefully or constantly avoiding them, and from absolute fear. No one will deny that cold, chilling draughts are bad, and are to be avoided. But any person may in a little time become so accustomed to mild draughts as to suffer no inconvenience from them; and any little discomfort at the beginning would be much more than compensated for by their invigorating effects and

the usual greater purity of the air, as when coming from outside into an unventilated or crowded room. One can often prevent the cold effects or chill by wraps or a screen. A coat collar turned up will often sufficiently protect the neck and face; and the high head-board of a bed divert the current. Be not, therefore, too much afraid of mild, pleasant currents of pure air. This, too, is advice given from personal experience and close observation.

A FEW WORDS TO PARENTS.

Parents with a predisposition to consumption should above all others be watchful of their children from birth. Even before the birth, the mother should be particularly careful in respect to her own health, and to that of her unborn offspring. She should breathe freely of pure out-door air; subsist on plain nutritious food, in judicious moderation, yet in plenty; keep the skin healthy by the bath and proper clothing; exercise or work moderately, never to over-fatigue; secure a full amount of rest and sleep; and never indulge to excess in *any* of the pleasures of life.

The child, from birth, should be especially cared for, and as Solles gives it, "on the lines of nature." It must not be overcared for or coddled, but rather cautiously hardened by cool bathing; and provided with abundance of fresh air, sunlight and suitable food and clothing. Above all, the respiratory function should receive attention as early in life as possible. So soon as the infant can walk well, it may be encouraged to run and romp and to climb, as up a stair or hill. As it grows up there must be no slackening in the care.

Encourage it to run and romp as much as possible with other healthy children out-doors in the sunshine. Boys usually get enough of this, but girls often, indeed commonly, do not. Encourage them, too, to run and romp and climb. Encourage all the little ones to sit, stand, and walk perfectly erect, with head and shoulders well set back. This adds much to their good appearance as well as to their vigor. Encourage them to use their lungs freely ; not to expand and develop them disproportionately, although hardly anything need be feared in this way, but to build up a full chest with good active lungs and heart. Special light gymnastics may be needed to aid in the development of the chest. Usually, however, free romping and climbing with habitual full breathing suffices. Encourage children early to breathe only through the nose by keeping the lips closed ; taking care that the nostrils are not obstructed. Their food must be always simple and digestible, yet nutritious; and their rooms—nursery and sleeping—well ventilated and lighted. The skin all through life requires special attention. It should be kept clean, soft and active by the bath and friction. When it is coarse and harsh, an occasional anointing with cod liver oil, followed the next day by a warm water and soap bath, will be beneficial, during early life especially. The school, as relates to its locality, structure and surroundings—to drainage, ventilation, cleanliness, sunlight, etc., should be looked after by the parents, and not left altogether to the authorities. Children of this class should never be sent to any school not

perfect in respect to these conditions; and perhaps above all, parents should see that the school is not in any measure overcrowded. Some boys, and girls too, acquire at school or elsewhere most depressing secret sexual habits, and this possibility should cause parents to exercise the most watchful care in this behalf. The choice of occupation must be also well considered.

As there is no doubt that infants may be born with the actual seeds of consumption—the tubercle bacillus or its spores—in their bodies, especially if the mother be in a marked degree tuberculous, then still more specific preventive measures may be demanded. If the infant appear to be puny or the nutrient or excretory functions not well performed, a physician should be consulted, and proper efforts made to correct these conditions and build up a more vigorous organism. Special nutrient food—oils, malt extracts, phosphates, etc.—may be required. Some of the nutrient or excretory organs may require stimulating into action, or be in an irritable condition and require sedative treatment. Only a physician can decide these points, and prescribe the required remedies.

Watch closely for any early, more marked symptoms of the disease, such as continued failure in appetite for food and loss in weight; always remembering that most persons, even children, lose in weight and take less food in very warm weather.

EARLY treatment, on the first manifestation of symptoms of the disease, is in some strongly predisposed persons, the *only* treatment that is likely to successfully combat its development and progress.

MARRYING AND GIVING IN MARRIAGE.

No two persons, each having a family tendency to consumption, should ever unite in wedlock. When both parents inherit a tendency to any defect, that defect is usually intensified in the children. Nor would it be safe or wise in such a case, of double heredity, to rely on time and hygienic measures to remove or destroy the predisposition, and marry later. Yet two such persons do sometimes so marry, and to the almost certain perpetuation of a fatal disease. That very affection—that love—which usually attracts to the marriage tie, should of itself restrain any man or woman in such circumstances from bringing upon the object of love the almost certain consequences of a diseased progeny. Full knowledge of the consequences, with a little reflection, should prevent such unions. Legislation in this behalf has been suggested. Very little practical good, however, would come from legal restriction. Parents and friends may sometimes do something towards preventing the consummation of unions of this kind. Usually all possible influence is brought to bear against misalliance in respect to wealth and social position. If like influence were exercised on behalf of purity and vigor of bodily constitution, an aristocracy of health might be looked for.

Everyone thinking of marrying should consider most seriously not only his or her own physical condition and family history in respect to disease, but also the health and health history of the person of the opposite sex who purposes entering into the

union; this not alone for the sake of the two contracting persons, but more especially for that of their probable offspring.

When the predisposition is only on one side—in only one of the contracting persons, and especially if on the other there be good health and vigor with a good history, the case is quite different. Burt says, "A man with a tubercular family history, and possibly a phthisical diathesis, should be made to understand that he is a potential source of much sorrow and misery if he selects for a wife a woman with a similar record and constitution. Contrariwise, an intermarriage with a family free from all such predispositions will do not a little to curb that downward tendency. A child with good blood for a legacy, even from one parent, has every reason to expect immunity from the disease, if he is reared intelligently." It should be borne in mind that sometimes by waiting a year or two the predisposition may be largely overcome by good living. Indeed in all cases of a predisposition, even on one side, there should be delay in marriage, with this view.

AVOIDING AND PREVENTING INFECTION.

We have seen that consumption is in a measure infectious: that in certain circumstances, as when one person for a length of time nurses another advanced in the disease, the infection—the bacilli, may be communicated from the diseased body to the non-infected one, yet one which has become in a measure predisposed. Anyone, then, having in any degree a predisposition, either inherited or acquired,

should avoid close intercourse with cases of the disease, as in the same household or family. The best and safest way to avoid "taking" any infection is by not providing the soil—by keeping the body in health and vigor. When the soil is favorable, or there is a predisposition, the only safe way is to avoid sources of infection, especially close intercourse with the infected.

When a member of a household has the disease, with cough and expectoration, such person should be in a measure isolated: provided with a well-lighted, airy room, or, better, two such rooms, so that he or she need not mingle with the family. Intelligent consumptives with proper feelings would prefer and desire this, rather than communicate their affliction to friends. The isolation need not be very strict: this especially if the case be an exceptional one in the family and the predisposition not marked; and with due care in the disinfection of all infected excreta. Separate rooms to live in—to sit in usually and to sleep in—are desirable. Other members of the family need not unkindly shun the afflicted one.

The first essential in preventing the spread of infectious particles is absolute cleanliness: cleanliness as perfect as can possibly be secured in everything and every way:—cleanliness or purity of the air within doors, of the body, of the bed and body clothing, of every corner and crack, of not only the sick-room but the whole dwelling. And this means, in the main, cleanliness from DUST, including sputa, particles of which may soon become dust, as may almost every form of dirt. In the dust of rooms, it will be remembered, tubercle bacilli have been found.

Bacilli form a part of the "elements of the dust." For clean, non-dusty air in rooms there must be thorough ventilation. In sickness of this nature free ventilation is demanded more than at any other time. Yet in practice we commonly find it quite the contrary: and this has cost an incalculable number of human lives. The unchanged air favors the predisposition and also the spread of the infection. Doctor Ransome has shown that in the back-to-back houses in the large cities in England, in which it is impossible to provide good ventilation, consumption is "excessively frequent;" and chiefly it is believed from this cause—want of ventilation. It is probable that in all those individual cases of consumption believed to have originated in infection, the brief history of which has been given in Part I., there was a want in this respect. And it is probable, too, that by perfect ventilation alone nearly all such cases would be prevented,—infection would hardly occur at all. Squire remarks, "It is a significant fact that nearly all the cases of probable direct infection from a phthisical patient take place in small and ill-ventilated houses, and are almost unknown in the airy houses of the well-to-do." Remember, sunlight, too, is essential.

The free flow into the rooms by night as well as by day of pure outer air will do the consumptive vastly more good than harm, provided he be kept a little to one side of any perceptible draught and clothed sufficiently. Patients in hospitals on the continent of Europe are now placed, well covered in bed, near a widely open window, aside from draught, in cold weather, night and day. In the New York Medical Jour-

nal (July 27, '95) we now read,—"M. Rochard remarks (Union Med.) that the mode of treatment instituted by Doctor Detweiler at the Falkenstein Institute was not at first taken sufficiently in earnest. The idea of consumptives living in the open air at a low temperature and allowing currents of air to pass through their bedrooms at night was looked upon as eccentric, but the advantages of this treatment have come to be recognized. The pure, cold air quiets the cough, lowers the fever, arrests the night-sweats, restores the appetite, and retards the course of the disease."

The first principle of ventilation, remember, is to withdraw the impure air from the room, as by a grate fire or warm flue, in order to make room for the pure outer air to enter. A layer of muslin, or cotton batting, in a wire screen, may be fastened across or over the open window, for preventing a too rapid inflow, or strong draught, especially when there is much wind or the weather is cold.

Floor cracks and corners are notable collectors and sources of dust and infections. A good moderate-priced "sanitary" flooring material is much needed. The cracks in ordinary floors may be greatly improved by being carefully filled with paper pulp and then oiled and varnished. Rooms or wards for the sick are now made without angular corners, in walls and ceilings, a cove taking the place of the angle, and without cornice and base, or any place for dust.

The less furnishings of any kind in sick-rooms the better, because the easier kept clean. Carpets, window or other curtains, and most upholstered furniture are particularly objectionable dust-holders. If they

are tolerated at all, they should be taken out weekly or oftener, shaken well and exposed for a time to sun and air. All bedding and body clothing should be so treated daily if it can be done. A few rugs on a well polished floor give a much better, because a cleaner, more appropriate or artistic, appearance than a carpet.

Dry dusting as usually practised stirs up the particles and is of very little benefit. All dusters should be slightly dampened by a sprinkling of water, or a weak solution of carbolic acid; or, as pleasanter, of a diluted tincture of an essential oil—cinnamon or wintergreen. They need not be made damp enough to appreciably dampen furniture. While in use they should be frequently shaken outside: but not, as often is done, directly in front of an open window while a current of air carries the dust directly back into the room. They may sometimes be shaken out well down below the window on the leeward side. Everything in the room on which it is possible for dust to settle must be gone over, and the oftener the better, if properly done and without "making a dust."

THE SPITTLE AND OTHER EXCRETIONS.

The expectoration or spittle of consumptives, containing as it usually does a great number of germs, must be carefully disposed of. From it, as we have seen, active virulent infection may directly arise: particles of it soon drying and becoming a part of the dust. It may so surround bacilli as to preserve their virulency for a long time.

Within doors the disposal of this source of infection is not difficult. Every particle of matter coughed up

should be carefully received from the mouth in a vessel containing a disinfecting solution, or into bits of rag or soft tough paper which should then be put into such solution. The cleanest way when the expectoration is not too copious is to wipe each sputum carefully and cleanly from the lips by rag or paper, so that no particle can fly off from the mass and escape and dry; as particles often do when one spits into a vessel. This, however, may be in a measure prevented by holding the vessel close up to the lips when it is used. Even then it is usually desirable to afterwards wipe the lips. Inexpensive paper cups may now be obtained for receiving sputa, which after use are destroyed with their contents. Probably the best way to finally dispose of sputa is by burning carefully in a large fire, as that of a furnace; but never in a small fire, as in a cooking or other stove. If thoroughly disinfected it may go to the sewer through the closet, or be buried in earth. The vessels, if not burned or buried, should be well scalded. As a disinfectant for receiving the sputa, corrosive sublimate is commonly recommended,—one part to 500 of water, or stronger. Carbolic acid,—one part to twenty of hot water—is an effectual germicide; and, if desired, its odor may be largely overcome by adding oil of cloves first dissolved in alcohol. These disinfectants are highly poisonous, and should be very plainly and strikingly so marked.

When out of doors, the consumptive should always carry rags or paper for receiving the spittle, to be afterward destroyed, and should never by any chance spit on a floor, sidewalk or other roadway,

yard or public place whatever. Flasks for spitting in which may be carried in the pocket are now made and in use. Pocket handkerchiefs for this purpose are decidedly objectionable. Washing them is not only disgusting but dangerous, from possible inoculation. Professor Graham mentions a case which came under his observation, in which infection was communicated in this way.

The body surface must be kept strictly clean. Spores, if not parent bacilli, are said to be thrown off by the skin. The whole body surface should be well washed daily with water, and the cooler this can be borne without much discomfort the better.

All other excreta as well as that from the lungs and skin should be also carefully disinfected. The mouth and nostrils should be often cleansed with hot water, to which some pleasant deodorant may be added.

After the death of a person from tuberculosis, all apartments which had been occupied by the deceased, at least, must be carefully disinfected before being again occupied. Everything movable should be taken from the rooms and disinfected by heat, as in boiling water, or by such solutions as already mentioned, and by free and long exposure to air and sunlight. The floors, walls, ceilings, and every corner and crack should then be thoroughly washed with hot water, soap and carbolic acid, or the corrosive sublimate solution, and be long opened up to air and light.

PRETUBERCULAR PREVENTIVE MEASURES.

Persons strongly predisposed to consumption, in the pretubercular condition, with loss of vigor and

perhaps of appetite for food and of body weight, while exercising more than usual caution in respect to infection, should also be more particular in carrying out instructions for increasing the respiratory capacity by lung gymnastics and habitual full breathing, as already pointed out. This, with an out-door life, moderate exercise and sufficient rest, judicious clothing and care of the skin by means of the bath, suitable, nutritious food, and a well-ventilated bedroom, is in many cases sufficient to restore health. In yet more extreme cases, more special nutrient foods besides oil, cream, beef preparations and predigested foods,—such as malt extracts, ale or porter, with phosphates, etc., may be required, and a physician must be consulted. A change of locality, too, may be desirable.

If space permitted, I should be pleased to give here, as profitable examples, the history of a few cases of the pretubercular condition, strongly marked—in persons thought to be "in a decline," in which I have observed entire recovery by means of increased lung capacity with attention to the skin, good ordinary nutritious food, out-door life, and a well-ventilated bedroom, in a salubrious locality: without any other remedy. Many such cases have come under my observation in practice. In a number of them, too, the patient had previously lived much out of doors, but with defective respiration. Such cases would well illustrate the power of simple, natural remedies, while explaining the cause of the body condition: showing, too, that it is sometimes enough to remove causes of illness in order to effect a cure.

CHAPTER XIV.

STATE AND MUNICIPAL PREVENTIVE MEASURES.

Some measures for the prevention of consumption, as well as of other diseases, cannot be carried out by individuals alone, and require united effort, as through municipal and even state authorities. The most important of these, as stated, and which promise the best results, are such as prevent or remove the individual predisposition to the disease. And most can be done in this direction by the education of the masses of the people rather than by coercive measures.

The better education of the masses concerning the ordinary requirements of health is indispensable to success in the prevention of any disease, certainly not less so in behalf of this most destructive of all diseases: education—warnings, directions, encouragements—in respect to personal habits and surroundings—to breathing, to foul damp air and sunlight, to cooking, eating, bathing, sexual relations, and to dirt in its various forms: education through the schools; by means of public lectures; and by free distribution of pamphlets. In country towns, villages and farm dwellings, as well as in large cities, sleeping apartments, for example, commonly, and often living rooms, especially

those of women and children, are such as should not be tolerated in this age—small, dark, dank and unventilated, with an atmosphere laden with poison from the breath and tobacco smoke. The human skin,—square miles of it, is so clogged from want of the bath and from habits of clothing that the lungs and kidneys are injured in efforts to do the extra work thrown upon them by the inactive skin. For the credit of humanity, as well as for pecuniary public gain and general welfare, there should be a decided improvement in health regulations and habits everywhere. It should not be forgotten that an entire community may be seriously injured by the evil influences—the carelessness, filthiness, diseased condition, of a very few persons, or even of one; and that want of knowledge of the sum of the evil consequences of living unhygienic lives is the principal cause of the bad surroundings. conditions and habits almost everywhere met with. There should be more united effort to help those who are not able to help themselves to an improved hygiene, and to compel those to do so who are not willing.

The united efforts now being put forth in some states and cities for preventing the dissemination of the seeds of consumption in the spittle of infected persons, by a certain amount of oversight of those suffering from the disease and of their dwellings, with instructions as to what they should do to prevent the communication of the disease to others, will doubtless be beneficial—bear good fruit. It is most desirable, however, that health authorities as well as individuals

should strike *first*, and in a more distinct or marked way, at the predisposing causes; treat these as of the first importance: strike for preventing the development of cases requiring oversight. This would be the true prevention. Public measures for this purpose are possible and practicable.

Health authorities should never do that which tends to prevent or lessen individual effort—to prevent persons from using means for individual or family protection, but on the other hand, should encourage self-effort for self-preservation.

Individuals must rely largely upon themselves, be a fortress unto themselves — keep their own body fortified. We must not expect the police to prevent our house being robbed if we harbor a robber in the household.

LINES OF LEGISLATION.

Legislative enactments and municipal by-laws as now commonly in force and intended for the promotion of the public health generally, tend also to prevent consumption. Enactments and by-laws more particularly aiming to prevent this disease should be on such lines as indicated by the following heads: (1) For the Better Instruction of the People in Special Preventive Measures; (2) Prevention of Air Fouling in every form; (3) Establishment of Free Public Baths; (4) Drainage of Retentive Damp Soils; (5) Inspection of Butchers' Meat and Dairy Products; (6) Inspection and Oversight of Schools; (7) Oversight in Certain Cases of the Disease; (8) Hygiene of Domestic Animals.

Unsuitable marriages is a subject which medical writers have suggested as one upon which there might well be some legislation. It has been stated that in Brazil, on account of the increase of "scrofula" there some years ago, a law was enacted providing for the medical examination of persons about to marry, and for preventing the marriage of those pronounced unfit. Laws of this kind would have little terror for those "in love," or who believed themselves to be. Education and the influence of parents and friends must yet remain the basis for preventing the marriage of consumptives.

Already in most countries there are certain legislative provisions applying to some of the above-named subjects (2, 4 and 5)—air fouling in factories, lodgings, etc., and drainage and food inspection. These provisions, however, are for the most part or generally not enforced as they should be; and although of some benefit, are probably in all cases far from being efficient.

PREVENTIVE EDUCATION.

The public schools provide an excellent means for instructing, theoretically and practically, the coming generation, and in a measure the present one, in ways for preventing consumption, if but taken advantage of. Almost everything is taught except health precepts. It would be much better to teach "language" relating to a good physical constitution than a foreign language; and better a health drill than even a fire drill. Pupils are not taught even the first essential

of right living—how to breathe; and those who do breathe properly do so in a large measure in spite of school influences tending to impede the respiratory function, such as foul air and a stooping posture.

Pamphlets with special instructions for preventing disease and promoting the general health, of both individuals and communities, might well be freely distributed, as well as the pamphlets on prevention of special diseases which health boards commonly distribute. And if such pamphlets were made more attractive in both appearance and style of composition, they would not be so likely to be "pigeon-holed" as some have been, it is said, on good authority. It must be remembered that although many good seeds are sown, comparatively few of any sort fall on good ground and bear fruit. Two to four page leaflets, clean, bright looking, large open type, on "How to Breathe," "How to Let in the Out-doors," "How Not to Cook," "What Not to Do for Health," and such like special, striking subjects, scattered freely about would be read probably by ten or more persons to every one who would even "look through" the heavier, dull brochures on the more repulsive diseases.

Popular lectures, particularly on the value of health, by a fairly good speaker would attract fair audiences and be largely reported in the local papers. Local medical officers in England have done something in this way—given such lectures. Why should it not be made a part of the duty of such officers on this continent to give courses of lectures, or "health talks," in various localities in their jurisdiction?

By such means generally and judiciously carried out, the great majority of the people, now so ignorant on this subject, would learn that good vigorous health is worth making an effort to preserve or obtain, and also, how to prevent disease, especially consumption.

STRICTER MEASURES: BETTER INSPECTIONS.

Stricter legal measures, or stricter enforcement of present measures, should be brought to bear on proprietors of all places where persons, whether only two or three or many, are employed at work—factories, shops, rooms, and also of tenements and lodging houses and hotels—for preventing every form of air fouling: from the breath, as in overcrowding with want of ventilation: from imperfect drainage and sewerage; from excess of dust in any form; and from infections. Every employer should be compelled to make such provision as would prevent any employed person, while actually engaged in his employ, from being injured in any measure by foul air, as well as by machinery, or accident; and every landlord should be under like compulsion in respect to every person for whom he provides lodgings, whether in tenement house, hotel or lodging house.

Compensation for damages sustained by an employee from impure air, for which his employer is responsible, it seems possible, might be recoverable at law even now; and this subject is well worthy of the serious consideration of employers. In a number of instances already the tenant has recovered from the landlord, through the courts, compensation for loss through sickness caused by an insanitary house.

Food inspection as now attempted, especially in respect to meat and milk, is little more than make-believe : as in the case of factory inspection, it is commonly done very perfunctorily. In some cases the inspector, often the market constable, probably does "the best he *knows how*" to do. Meat unfit for food is sold everywhere ; and while watering milk, a comparatively harmless offence, is in a measure prevented, diseased dairy cows and foul stables, vastly more harmful than watered milk, exist on every hand.

SUB-SOIL DRAINAGE.

Thorough drainage of the heavy damp sub-soils on which cities and towns are often built would probably be a better investment—yield larger returns for the outlay, in improved health and vigor of the population and the exemption from consumption and other diseases, than is obtained by even the agriculturist by the drainage of farm lands. Statistics have proved, it will be remembered, that consumption is more fatal on damp than on dry soils. Sewerage, it may be noted, is in no sense drainage of the soil. The sewage of a city may be well carried away by house drains and sewers, and yet the sub-soil remain damp. Tile drainage, with tiles thickly set, is what retentive soils need. There should be some means for preventing the erection of habitations on damp soils.

MEAT AND MILK REGULATIONS.

For preventing the sale, all too common, of tubercular and other diseased meat, public slaughter-houses

should be provided in which all animals intended for food should be killed and cut up. Here all the animals should be examined by a competent inspector both before and after slaughter. It is well known that consumption is less prevalent amongst the Jews than other people, and this is properly attributed to the care they bestow in the selection of meat. This matter is one of serious importance. The Editor of the British Medical Journal, in a leading article (June 15, '89), writes, "The subject has a most important bearing on public health. It is one that must be taken in hand by sanitary legislators, and the sooner it is tackled thoroughly and on the broadest possible basis the sooner shall we obtain a cleaner bill of health under the heading 'Tuberculosis.'" There has been considerable agitation for public abattoirs on this continent, but little has yet been done in this way. It is now generally conceded that, when an animal becomes tubercular in any organ, both the meat and milk are unfit for food, although the flesh and udder may not be locally diseased. It was so decided in a strongly contested case in Scotland a few years ago after the evidence of the highest authorities in Great Britain had been heard.

Milk supply regulations are really of greater importance than those applying to meat, because milk is more commonly used in an uncooked state, is in many cases the sole food of young children, and dairy cows are more commonly tubercular than other bovines. Yet all regulations affecting it are inefficient and lax. To look after the cows—their health, food,

drinking water and housing—is by far the more important part of inspection. A good model for municipalities to adopt is the milk supply system in the city of Copenhagen, probably the most complete to be found. The regulations are given in the Canada Health Journal of December, 1891.

The Royal Commission (Gt. Brit.) appointed five years ago to enquire into the question of tuberculous food have recently reported: in effect, that,—in an appreciable part of the tuberculosis in man the infection comes from food, chiefly from bovines; tuberculous milk and dairy products are exceptionally active when fed to animals; and (contrary to the decision in the Scottish case) a great deal of the non-tuberculous *flesh* of tuberculous animals may be eaten if care be exercised in removing all diseased parts and organs, and in cooking the flesh.

PUBLIC BATHING CONVENIENCES.

Enough has been written elsewhere herein on the value of universal or public bathing. As Doctor Simon Baruch (as before cited) says, "It requires no argument to prove that every consideration of law, propriety and sanitation demands that our city authorities take immediate steps to secure to our laboring population near their dwellings, and in the school buildings, station-houses, etc., the means of cleanliness and refreshment, health preservation and moral improvement, which the public bath is more capable of furnishing than any other more costly investments, and to sustain all benevolent societies who are striving in the same direction."

Rain baths of tepid or not too cold water are by far the best form for public use: the most effectual for cleaning the body and most attractive for most persons, for winter and summer use. They should be in the centres of the most populous localities. The New York State Legislature has just recently enacted a law making it mandatory for cities with 50,000 of a population or over to establish free public baths, and also providing for more efficient action in this behalf by the smaller cities. This is a leading movement which should be followed by all legislatures.

SCHOOL PUPIL MANAGEMENT.

If every pupil on the commencement of school attendance were examined by a physician, or if examinations were made monthly of all new pupils, and every one wanting in full breathing capacity, or with a chest girth below the full average, or perhaps not above it, and everyone with a stoop or round shoulders, were placed for a sufficient length of time under special treatment for chest development, the number of cases of consumption would soon be much reduced. Other physical defects, too, could be remedied at the same time. Such pupils, and there are many, could be treated in classes, usually by the teacher, under medical oversight. Fuller details than have been given elsewhere of the various special exercises required cannot be entered into in this treatise.

A system of this kind, efficiently carried out, and with a strong impression made on the mind of the pupils as they grow up, as to the value of a good chest

and full breathing, would probably do more to prevent consumption than any other means that could be adopted. In this way the very youths predisposed to the disease—marked out as it were for it, thousands of them, from whom, only, or almost only, consumption eventually draws its double tithe, would be reached and rendered practically immune.

OFFICIAL MANAGEMENT OF CASES.

Instead of compulsory notification, registration, and even isolation, which has been proposed as a measure for the suppression of consumption, and which would doubtless create opposition and concealment of cases, it would be probably wiser for health authorities to adopt the simpler, less extreme plan of leaving the question of notification largely or wholly in the hands of the medical attendant in individual cases. The authorities might request all physicians to give notice of such cases coming under their observation as in their judgment required oversight and assistance in carrying out measures for preventing the spread of the disease; to cases in which neither patients nor friends, from want of means, were able of themselves to carry out such measures. This would limit notification to those to whom the aid of public officials would be not only acceptable, but desired. The public assistance given would more than compensate for the semi-publicity. This appears to be about as much as the public are prepared to fully sanction; indeed about all that is required, in this line of action.

Supplies of printed instructions should be given

by the health authorities to all physicians for putting in the hands of consumptive patients of all classes or of the family or friends. Formulas for such instruction may be easily made up from what has been stated herein: Chapter XIII, preventing infection, etc.

HYGIENE OF DOMESTIC ANIMALS.

This is a subject so directly associated with milk and meat inspection that it is desirable to touch upon it here. Were due attention given to the hygienic care of animals, they would be kept practically free from disease, and the inspection of these foods would be a comparatively simple and easy matter. The following remarks (extracts from a pamphlet on the subject by the author) may impress upon the reader the desirability of having more special attention given by dairymen and others to the health of the animals, and is all that can be given herein: "Fleming says (Vet. Sci.), 'A rational and well-founded system of hygiene, by fortifying the body [of animals] and preserving the different organs in health, is the most certain safeguard against the development of disease.' As in the case of man, so in that of animals, pure fresh air is first in importance. Grognier asserts that horses and horned cattle suffer more than man or carnivorous animals when kept in a bad atmosphere, and he has described a 'stable fever' in animals in France, analogous to the now past 'hospital fever' or 'prison fever' of man, from breathing the foul prebreathed air of stables.

"The worst sort of foul air to which domestic

animals are exposed, and which is most common, is (1) that which has been breathed, and rebreathed over and over, again and again, in close unventilated stables, and (2) that from manure piles in and near stables and yards. Fleming quotes an author as saying that 'stables should smell no more of the animal than the dwelling room does of the man.' Parkes says, 'A horse or cow ought to have from 10,000 to 20,000 cubic feet of fresh air per hour. It ought to be practically in the open air. . . . Animals properly fed will thrive better in a well-ventilated place at a low temperature than in a warmer place ill-ventilated.' Besides the value of pure air from a strictly health point of view, reports have been published of experiments which prove that cows yield more and better milk when kept in clean, well-ventilated, than in close, foul stables. Cattle do better on the whole in large open sheds with abundance of straw than with the more modern practice of 'stabling.' Large sliding doors might be provided which could be used for closing the open side of the sheds during the hours of a cold storm from that direction. Cows often require more exercise, probably a good gallop daily. It might lessen the quantity of milk given, but would improve their respiration, health and vigor."

It would be well if heads of families would by careful inquiry and even personal inspection see that the cows which furnish the milk supply of the family were suitably housed in well-ventilated, well-lighted, clean, dry apartments and receive only good

pure food, pure water and sufficient out-door exercise. Such personal looking after by directly interested persons would soon improve the milk supply.

SANATORIA OR HOSPITALS FOR CONSUMPTIVES.

These are amongst the most useful means for the practical prevention of this disease by the State. As a large proportion of consumptives are of the laboring or poorer classes, who are often not able to provide for themselves the means of proper treatment, it is contended that the State should provide institutions of this kind. To do so would doubtless be a wise expenditure of public money. In England it is believed that the hospitals for consumptives there have contributed in a large measure to the decline in the mortality from this disease during recent years. While the hospitals serve to isolate cases and prevent new ones arising through infection, they also prolong life and so reduce the annual mortality. Many cases, too, are practically cured, chiefly by means of the greatly improved conditions of life in which patients are placed as compared with their previous conditions.

In the general hospital, consumptives are not only liable to infect other persons, but they are themselves under great disadvantages, in many and obvious ways. When, therefore, it is possible to avoid it, they should not resort to, or be sent to one.

Sanatoria—a name which to many persons is yet less unattractive than the term hospitals, although these institutions are not nearly so unattractive now as they were a few decades ago—should provide for

at least two, and better three, classes of cases,—classified according to the stage of the disease. For persons in the early stage a separate building should be provided. If they are treated in one with advanced cases, not only would there be greater risk from reinfection, but the mental effect from proximity to the more seriously diseased, sometimes dying patients, would be decidedly depressing. A second building should be provided for persons in the later stages, with yet hope of recovery: and a third for incurables, requiring isolation in the public interest. For the first class, and in the main for the second, only apartments would be required in which to sleep, eat, receive baths, massage and other treatment, as the patients should live mostly in the open air—lying, sitting, walking, driving, riding, playing at games, skating, tobogganing, coasting, as most suitable. It need hardly be stated that such sanatoria should be in the most select localities, constructed on the most approved modern principles, as to ventilation, sunlight, dryness, etc., and be under the constant supervision of the best medical skill.

There are many cases in the early stages of the disease which need not remain long in a sanatorium. After being, there, placed in a fair way for recovery, with proper instructions and injunctions as to their future course,—after being taught how to live—they could leave and engage in some suitable employment. Or, if a farm were connected with each sanatorium, such patients could be employed on it with profit to both themselves and the institution.

CHAPTER XV.

CLIMATE AND PREVENTION.

THE somewhat extended remarks on climate in the following pages need no apology. The subject is a very important one: change of climate is a remedy frequently resorted to, both as a preventive and curative, for consumptives. Yet the effects of climate or of acclimatization on the human functions are not yet well understood.

WHAT IS CLIMATE?

Of climate (Greek, κλίμα, a slope,—toward the poles or sun), Parkes says, it is not easy to give a definition. "The effect of climate on the human body is the sum of the influences which are connected either with the solar agencies, the soil, the air, or the water of a place, and as these influences are in the highest degree complex, it is not at present possible to trace out their effects with any certainty. . . . Probably we do not know sufficiently the physiological conditions of the body under different circumstances." (A. E. Parkes, M.D., F.R.S., Prof. Mil. Hyg., Lond. Eng. Man. Pract. Hyg., sixth ed. Vol. II.)

According to Humboldt, "The term climate, taken in its most general sense, indicates all the changes in the atmosphere" as to temperature, humidity, purity,

movement (in winds), variation in the barometrical pressure, etc., which "sensibly affect the organs" and influence "the feelings and mental condition of man"

Professor Sir Wm. H. Hingston, M.D., D.C.L., etc., in his "Climate of Canada" (Montreal: Dawson Bros.), says, the various conditions influencing climate may be "reduced to two: distance from the equator and height above the level of the sea." "Heat is the controlling condition;" but "the atmosphere modifies all the effects of the sun's rays." And, "It would seem as if this branch of medicine must ever remain to some extent conjectural."

Briefly, climate is the *condition* of the atmosphere in which we live: which we must breathe. This atmosphere, however, is incessantly changing, by reason of the many and various influences above indicated:—of the sun; of the seasons and special fixed aspect of the earth's surface toward the sun; of geological and geographical conditions; of other or adjoining countries or localities and of the ocean; and of influences of a more local character,—soil, vegetation, subterranean water, etc. So delicate and intricate are some of the atmospheric or climatic changes that no way or method has yet been devised for detecting or explaining them: the human body when in health may not: although when rendered supersensitive by derangement or disease it may perceive them by their effects.

As Doctor Ferrier has remarked, "Nature as if in ridicule of the attempt to unmask her, has reconciled contradictions and realized improbabilities with a mysterious versatility, which inspires the true philoso-

pher with diffidence, and reduces the systematic to despair."

While on some parts of the earth the atmosphere is such that man cannot long survive in it, and in others he cannot live long in health and comfort, in most parts, with reasonable care, he can live to the most advanced age. As already has been intimated, usually the question of life and health is more in his controllable habits of life than in the climate. The climate is often blamed when man's habits—of diet, of clothing, of housing—are chiefly at fault. Yet there are but very few places of which it can be truly said:

> "So sweet the air, so moderate the clime,
> None sickly lives, or dies before his time."

THE ATMOSPHERE AND THE BODY FUNCTIONS.

Some of the direct effects upon the human body of the atmosphere surrounding it—that is, effects of climatic conditions, are generally well known. Such are the depression caused by a damp, heavy atmosphere, acting chiefly on, and checking, the function of the skin: and, on the other hand, the exhilaration produced by clear, dry, "ozonous" air: the characteristics of race, etc. There are certain more specific effects, too, of much importance. Stimulation, for example, is the first effect of heat. This is followed by reaction and depression, even to collapse. Heat relaxes; while its absence, cold, in a measure, gives tone,—we might say firmness, stiffness. This has led to contrivances for cooling the air in hot climates or seasons.

The warmer the atmosphere the less oxygen it contains, bulk for bulk, and the more the respiratory function is reduced; and usually the more active is the skin. According to Parkes, A. Ratray, M D. (Surg. R.N.: Proceed. R. Soc., Lond.), made observations on the weight and height of forty-eight naval cadets, aged from fourteen and a half to seventeen years, during four successive changes of climate during a voyage. The results show that in the tropics they increased in height more rapidly than in cold climates, but that they lost weight very considerably, and in spite of their rapid growth, Ratray concludes that "the heat impaired the strength." Parkes adds, "His figures seem conclusive on these points, and show the beneficial influence of cold on youths belonging to races long resident in temperate climates."

Cold air, while it contains, in a given portion, more oxygen than warm, also necessarily expands more while its temperature is being raised to that of the lungs after it is inspired, and thus it aids materially in the distension of the lungs.

Frequent exposure of the bo ly to alternate heat and cold, either by means of air or water, undoubtedly gives tone and vigor to a weakly person. Much care, however, must be exercised in the beginning of such hardening process.

Humidity modifies the effects of the temperature of the atmosphere and causes it to produce depressing effects upon the body, chiefly by checking the perspiration. Great humidity with warmth is, however, usually better borne than with cold. In

advanced chronic lung diseases, a moist, warm atmosphere usually allays cough; while a dry one appears to often irritate the lungs. Malarial diseases, it may be noted, attain their greatest activity with the greatest humidity of the atmosphere. Small-pox is checked by a very dry atmosphere, and cannot be even inoculated, it is stated, in the dry winds in Africa. Humidity favors the development and spread of infections generally. It is well known that dry air retards decomposition, and that moist air is favorable to the growth of fungous plants.

The effects of movements of the air—winds, depend on three conditions: temperature, humidity and velocity. Calm, dry Arctic air can often be well borne, but when moving or moist it becomes unbearable, by chilling the body.

The lightness or the weight—pressure, density or thickness, of the atmosphere is a very important condition of it. The pressure of the denser air at sea level being fifteen pounds to the inch of surface, and at an elevation of 16,000 feet only about half that, the air at the latter point contains only half as much oxygen, bulk for bulk, as at the sea level. At the moderate elevation of 6,000 feet, the quantity of oxygen in a certain bulk of air is 20 per cent. less than at sea level. In order to compensate for this, a person on ascending must and does breathe a proportionately greater volume of air. One going suddenly from a low point to a high one, experiences shortness of breath, and breathes more rapidly even when at rest. When the altitude is not great, the

breathing gradually becomes less frequent, but deeper, fuller and longer, and remains so. Hence the large chest of the mountaineers. The physiological effects of the lessened pressure and thinner air, as one ascends, is not usually perceptible below 2,000 feet.

Some remarkable effects of altitude on animal life are mentioned in a report of Medical Inspector Gibbs, U. S. Navy (Climatol. U.S., A. N. Bell, A.M., M.D. New York: Wm. Wood & Co.). On high mountains in Peru, almost under the equator, "positive degrees of heat and cold meet on such sharp lines" that they cause "violent reflex action, shock, paralysis," severe and sudden pains in men, causing them "to double up:" and such effects on birds while flying in the air as to cause them to fall suddenly to the ground dead.

As in direct contrast to the effects of the thin air of high mountains, it will be well to notice here some effects of compressed air. For centuries, observations on these have been made by physicians and others, in diving-bells and in special air-tight chambers. The caissons used in recent years in constructing in deep water the foundations of great bridges have afforded excellent opportunities for the study of these effects. Parkes asserts that at a pressure of $1\frac{1}{4}$ to 2 atmospheres the pulse and respirations become slower: and that it is said (Foley) that more oxygen is absorbed and venous blood becomes red, like arterial blood. Doctor Andrew H. Smith, of New York (Phys. Presb. Hosp., late Surg. N.Y. Bridge Co.), in a work on this subject (Detroit: Geo. S. Davis), remarks as follows: "Compressed air tends to expand the

pulmonary air vesicles, increasing the vital capacity, and may be used to restore the permeability of air tubes occluded by exudation or otherwise. In its chemico-physiological action, the indications are to be found in the increase which it occasions in the amount of oxygen taken up in the lungs, and the improved condition of the blood which results. This is shown in the more rapid oxydation of the tissues, in the greater activity of the vital processes, and in increased muscular power. . . . The narrow chest, more or less flattened, . . . with restricted respiratory movements, acquires under the mechanical action of the condensed air and the improved nutrition of the respiratory muscles a greater range of excursion; the undeveloped anæmic and vulnerable lungs become more or less expanded; and the frequent and superficial respirations less frequent and deeper. . . . Oertel gives it great prominence, and believes it will often accomplish much more than change of climate."

CLASSIFICATION OF CLIMATES.

In systematic works a variety of climates is described: cold and warm; cold and damp, and cold and dry; warm and moist, and warm and dry; ocean climate; forest climate; and that of much elevated regions—elevated climate, distinguished by a thin or rare atmosphere, cool, dry and changeable. Space will not permit of details here descriptive of these varieties, nor of the climates generally recognized as most suitable for the different temperaments and constitutions of consumptives and the various stages of the disease.

A few leading points, however, may be noticed as bearing more especially on prevention.

A Cold Damp Climate is not favorable to human life and health generally, and should be avoided by consumptives.

A Cold Dry Climate is, on the other hand, invigorating and generally acknowledged to be best of all for persons who are predisposed to the disease, or those in the earlier stages who have strength to take considerable exercise in the open air: this being more especially the case if such be their native climate. When consumption develops in a cold dry climate it is owing to local influences: for the most part to habits of life therein; and usually, much more than to anything else, to housing in close, overheated rooms and inattention to the skin, by which extra work is thrown on the lungs.

In Warm or Tropical Climates there is less outlay of energy, which suits debilitated feeble persons.

Warm and Moist Climates, such as those of Florida, the West Indies, and Madeira, are enervating, and now usually only advanced or excitable cases, or those with a good deal of cough from bronchial or laryngeal irritation, are sent to them.

Warm Dry Climates are more resorted to, as being more suitable to a larger proportion of cases: such are those of Mexico, southern California and some parts of the Mediterranean coast. Arizona and Egypt (upper) afford the more extremes of this sort of climate. Consumptives in these have no difficulty in keeping out constantly in the open air, while they

get abundance of sunshine. Some persons in the earlier stages, or when only predisposed to the disease, derive benefit, which, however, is not infrequently only temporary; especially, in my experience, in those accustomed to a colder, more tonic atmosphere. Within the present year, a man, aged forty-five, a native of Ontario, still well able to attend to his business, and who with reasonable care in his native climate might have lived many years, if not to a fairly advanced age, went to California, near Los Angeles, and died in less than a year.

OCEAN CLIMATE.

The most notable characteristic of sea air is its very high degree of purity and freedom from organic emanations—bacteria, vapors, gases, and from particles of dust, or substances liable to irritate the lungs. Hence from this alone life at sea is of great benefit to some consumptives. Usually the air has a calming effect on the nervous system, too; its temperature is more equable than on land; and its oxygen is apparently in a most active, invigorating condition,—highly electrified and ozonous. Sea air is somewhat more humid than land air of corresponding latitude; but so far as this may be objectionable, in itself, in certain cases, other qualities fully compensate for it. It is possible that the iodine, chlorine and bromine in the air at sea may have a beneficial—an "alterative," effect on the human organism. Like many other of the climatic conditions and effects, however, these are not yet well understood.

Amongst sailors the mortality from consumption is comparatively very low. William S. Wilson, M.R.C.S.E., etc., in "The Ocean as a Health Resort," has drawn attention to the fact that "the registration return of deaths amongst sailors of the mercantile marine show that the proportion of deaths from consumption as compared with those from other causes is ten times less than it is amongst the English land population," and that between the ages of fifteen and forty-five, it is "sixteen times less at sea than on land." Sir B. W. Richardson has stated that in 1856 Bowden showed that, while the deaths from consumption in the British army were, in the Line, 8.9, and in the Guards, 12.5, per 1,000 men, in the Navy, from 1830 to 1856, only 1.76 per 1,000 died of it.

A life at sea, for one predisposed to phthisis, and inclined to such a life, is certainly to be recommended, though rarely absolutely necessary.

A sea voyage, especially a long one, is in some cases advisable. Cases in which the most decided and permanent benefit followed a long sea voyage have come under my observation. The risk of seasickness, however, of undue excitement and anxiety in rough weather, with the impossibility of turning back if the life proves objectionable, must not be lost sight of.

Modified sea air, as on sea-coasts and islands, is in some cases of benefit. It is not so pure and uniform as out-at-sea air, but in a few localities is a very good substitute. The nature of the soil, aspect, prevailing winds and other conditions, must be very carefully considered in making a selection in any case.

HIGH MOUNTAIN CLIMATE.

High mountain air is peculiar in that from its thinness and smaller oxygen supply it necessitates greater activity in the breathing movements; an indispensable condition in both the prevention and cure of consumption. Elsewhere have been noticed some effects of altitude on the body functions. By the fuller breathing, the smaller quantity of oxygen in the air appears to be compensated for in suitable cases, and general permanent benefit follows. A young man with a proportionately small or inactive chest, either partly or wholly inherited, or acquired by habit, and so predisposed to the disease, is usually benefited by residence in a well-elevated locality. A more active respiratory function is forced upon him: he is compelled to breathe deeply. The membrane forming the air chambers instead of continuing in a measure contracted and thickened, becomes active, distended, thinner, and positively cleaner, and the function of respiration is more perfectly carried on. The lungs become a less-fitted soil for tubercular deposits. If such young person have no particular home ties or business relations, and would be as contented away from home, and with means to go without deprivation, and make a home there; and more especially if he be somewhat indifferent about his health or condition, and not disposed, from carelessness or other cause, to use special means at home for removing or overcoming his predisposition, he prob-

ably should be advised to make his home in an elevated locality. He will there be actually compelled to take longer, fuller inspirations. These are the sort of cases that are most benefited by such a climate.

Persons in the early stage of the disease, not much debilitated, with little or no fever or consolidation of the lung tissue, nor bleeding therefrom (hæmoptysis), and especially if the disease be making but slow progress—very chronic, and who are not of an excitable or "nervous" temperament, are not infrequently benefited, and permanently, by an elevated climate. Those further advanced, or who cannot take considerable exercise, or are erethic, easily excited or disturbed, should not risk the change.

It is quite generally believed that inhabitants of high mountains are exempt from consumption. It appears, however, that development of the disease is not uncommon now in some elevated cities in Colorado and Mexico. Local influences — overcrowding and want of ventilation, eventually produce their predisposing effects in high as well as low cities. Once introduced, it spreads to the susceptible by infection. On the authority of Parkes (Pract. Hygiene), "Although on the Alps phthisis is arrested in strangers, in many places Swiss women on the lower heights suffer greatly from it; the cause is a social one: . . . ill-ventilated, low rooms: . . . constrained position, poor food. Scrofula is very common." It is now known, Parkes says, that "great

ELEVATION IS NOT NECESSARY

for the cure of phthisis." "It would even seem possible that, after all, it is not indeed elevation and rarefaction of air, but simply plenty of fresh air and exercise, which are the great agents in the cure of phthisis." Neither is it necessary, certainly, for the prevention of the disease. Ziemssen (Clin. lect.) says of mountain health resorts,—"Their success seems to depend not so much, if at all, on elevation of site as on the purity of air and exercise of the lungs." Davis, who is decidedly favorable to mountain climate, in his latest work, referring to respiratory gymnastics, writes as follows: "The respiratory muscles are strengthened and trained to involuntary mountain deep breathing. The chest can be gradually thus enlarged quite as much as by high-altitude life, provided only one will be sufficiently persevering." On another occasion he writes respecting mountain-air:—"It often stimulates the ambitionless and lethargic to take the all-needed exercise,"—of the lungs. Denison (of Denver) says, "The mountain configuration of most high places invites to hill-climbing, and the increased radiation of heat due to rarefaction and dryness is a natural incentive to, or substitute for, exercise. These agencies are to be preferred because they are natural; and besides the enforced observation of artificial rules is less imperative in high altitudes." It is clearly evident then that the best authorities, those who have had best opportunities of knowing, believe that the beneficial

results of an elevated climate are produced by an increased respiratory function in pure air: as Ziemssen remarks they depend on the purity of the air and the exercise of the lungs.

Furthermore, theoretically, we would naturally suppose that the lungs could be gradually enlarged and respiration improved with greater safety—less risk from hæmorrhage, by careful lung exercises at home, in the native climate, than by a comparatively sudden change to an elevation. Localities with practically pure air and other favorable conditions can be found in almost any country or part thereof.

FOREST CLIMATE.

Forest climate, especially that of pine forests, has been highly extolled. An abundance of sunlight can of course be always obtained in a piece of open. The effects of forests on the atmosphere resemble in some respects those of the sea; more especially do they equalize temperature and humidity. Pine and other balsamic trees produce an aseptic condition of the air which is thought to be highly salubrious; while the pine especially, in its root growth, greatly favors subsoil drainage. Doctor A. N. Bell (in Climatology, as quoted) says, "The effect of forests on the electrical states of the atmosphere, and the generation of ozone, is doubtless a force of great influence, adding to the general salubrity, and under some circumstances giving them special potency." Forests afford great protection from the effects of winds, cold or hot; and also from "malaria." It is said the interiors of the

great "dismal" swamps of Virginia and the Carolinas are not insalubrious, like it is near the treeless borders.

Doctor F. L. Oswald relates (Pop. Sci. Monthly, Vol. XI) that the Prince de Ligne wrote an essay "On the Location of the Earthly Paradise," in which he calls attention to the fact that "paradise traditions, in locating the garden of Eden, differ only in longitude, not in latitude. The latitude keeps always near the snow boundary, a line just south of the regions where snow may fall, but will not stay on the ground. It passes through Thibet, Cashmere, northern Persia, and Asia Minor, reaching the meridian of Europe near the centre of the Mediterranean." Doctor Oswald adds, "We may doubt if in the most favored regions of the New World, human industry, with all the aids of modern science, will ever reunite the opportunities of happiness which Nature once lavished on lands that now entail only misery on their cultivators," and this because of the "insane destruction of the forests."

ACCLIMATIZATION.

Acclimatization is a physiological process the possible injurious effects of which upon non-vigorous, debilitated, susceptible persons, it appears to me, are almost entirely overlooked when considering the question of a change of climate. The human body when in fair health can soon adapt itself to much changed surrounding circumstances, but not without a certain expenditure of force or energy. Consumptives have little or no energy to spare for anything not indispensably necessary. It is well known that the body

functions of a healthy vigorous man are sometimes much disturbed by the change. The disturbing effects are probably exerted, in a measure, upon every organ and function. Can we ever be certain that any benefits which may be produced by a change, as, for example, from a cold or temperate to a warm climate, where, it is true, the lungs may be relieved by more work being thrown upon the skin, will compensate for any ill effects which the change, particularly at first, may exert upon other organs of a consumptive?

Respecting the change from a temperate to a tropical climate, Parkes (E. A., as quoted) says, "How soon the body, when it has become accustomed by length of residence for successive generations to one climate, can accommodate itself to, or bear the conditions of, the climate of another widely different place, is a question which can only be answered when the influences of climate are better known. . . . Certainly it would appear that, in India, there is some evidence to show that the pure race [European], if not intermixed with the native, does not reach beyond the third generation." Sir W. Moore (paper before Epidemilog. Soc. Lond., '91) maintains that great as is the power of accommodation possessed by individuals, each race is especially fitted for certain climatic conditions, which tend sooner or later to eliminate the unfit. He believes that an infusion of native blood is essential to the permanent existence in one climate of immigrants from another and very diverse one: and gives examples, in respect to India and South America (Can. Health Jr., Ap. '91).

Changing to a colder climate, strange as it may appear to some persons, seems to produce a good effect eventually. Respecting Anglo-Saxon and Celtic races going to live in a climate with a lower mean temperature and greater variations than their own, Parkes observes, " We have the experience of Canada and some parts of the Northern American States, in which, if the food is good and plentiful, health is not only sustained, but is perhaps improved. . . . Certain it is that in those countries the European not only enjoys health, but produces a progeny as vigorous, if not more so, than that of the parent race."

The intense effects of great altitude upon the body have been already noticed. At lower levels of course the effects are less marked. At an altitude of about 3,000 feet they begin to be decidedly perceivable: quickened pulse and respirations, lessened spirometric capacity and increased evaporation from the skin and lungs (Parkes). Doctor Charles Fayette Taylor (Proceed. N.Y. Acad. of Med., Oct. '94) informs us that " Whether it be due to the increased action of the heart in the rarefied atmosphere, the constant hammering of the nerves by the winds and the fierce sunshine, or all these and other causes, people in those [elevated] regions have a thin and tired look, and it is found useful and often necessary, especially in cases of women and children, to visit lower, damper and more germ-laden regions" in order to recuperate. To the susceptible " nervous" consumptive such a climate is not suitable.

CHANGE OF CLIMATE UNCERTAIN AND EMPIRICAL.

With the present want of knowledge of the relations to, or effects upon, the body of the numerous and varying conditions of the elements of the atmosphere, or climate, some special conditions of the oxygen of which have yet to be referred to, the practical application of climate to consumptives either as a preventive or therapeutic remedy seems to be in most cases uncertain in a high degree, and is almost wholly empirical. Over half a century ago, Sir James Clark, M.D., etc. (Cyclop. of Med.), wrote,—"Since the nature of phthisis has been more fully understood, the expectations from climate as a means of cure have greatly abated, hence it is much more justly considered simply as a preventive . . . during that peculiar state of deranged health observed before the disease has manifested itself in the actual development of tubercle. If it has disappointed as a curative agent, how far can it be relied upon as a preventive? To be sure, before the increased debility consequent on the formation of tubercle the patient could the better bear acclimatization. One of the latest authorities, Doctor Squire, already quoted, remarks that, "Years ago Madeira was the chief health resort of consumptives, and all sorts of cases were sent there. Next the south of France came into vogue, and thousands of consumptives flocked to the Pyrenees or to the Riviera. Then came the turn of the mountain climates and the Engadine, and the clear air of the snowy mountains and altitudes of Switzerland dispute the claims of the dry sandy

plains of Egypt and the African shores of the Mediterranean or those of its more attractive northern coasts." These places, Doctor Squire adds, "are all suitable health resorts for consumptives, if proper selection is made of the kind of case to be sent to each." Just so: but with the present limited degree of knowledge on this subject, how is the selection to be safely made? Doctor Davis (before cited) observes that, the selection of a climate is frequently made easier by watching the effect, in a given patient, of different kinds of weather, especially of bright, warm, moist days, and bright, warm, dry ones. And Doctor Frank S. Parsons (Ed. "Times and Reg.," med., Phila.) says, "The only way to test a location" is for the person to "try the various localities," if practicable, and make a permanent abode in the one which agrees best with his individual constitution.

In view of all this, and of well-known highly unsatisfactory results from change of climate, especially from a cold to a warm or thin atmosphere, should not, usually, every other remedy be first tried in all cases of consumption or of predisposition to it?

ESSENTIAL CLIMATIC ELEMENTS OR CONDITIONS.

There are certain elements of the atmosphere which are absolutely indispensable for either the successful treatment of consumption or for removing or overcoming the predisposition. These relate particularly to the purity, temperature, humidity and movements of the air and, perhaps more particularly, to the condition and proportion of its oxygen.

The degree of purity or non-purity of air is now usually based on the number of bacteria, or germs, it contains. Gases or vapors from the ground or other source may perhaps be sometimes in the air which produce effects upon the body more important than those which ordinary bacteria produce, but about which nothing is yet known.

Germless air (practically so) is found only (*a*) out at sea, where germs are not developed, (*b*) on mountains 5,000 feet high or upward, whence any micro-organisms which may be developed gravitate readily through the thin mountain air away to lower, heavier strata, and (*c*) on expanses of country, not too near a city, well covered by snow. As Doctor Squire says, "Any snow-covered expanse has for a time—and in some places, as in parts of Canada, for a long time—a comparatively germless, and so a healthful air; and these, though not at any great altitude, help to supply the want that mountain climates satisfy."

Besides these, there are many rural localities in most countries sufficiently elevated for good drainage, with a sandy, gravelly or rocky soil, or a richer soil with sufficiently abundant, salubrious vegetation, in which the air is sufficiently pure and restorative.

The temperature of the air is a condition upon which its suitability for consumptives has been most largely based. These persons usually require, most of all, "tone." Warm air is relaxing rather than toning. The colder the air that can be borne, or within reasonable limits, the better, the more oxygen it contains, in a given bulk, while at the same time the more

invigorating this vital element seems in itself to be. The air should not be humid. The effects of sudden changes of temperature, as already stated, are invigorating: and Parkes says, "It is astonishing to find how well even phthisical persons will bear great changes of temperature if they are not exposed to winds." At Nice as the sun approaches the horizon the thermometer falls 25° F. in an hour. Sudden changes constitute one of the most marked features of the thin atmosphere of high mountains. At Davos (Switz.), less than six thousand feet above the sea level, a special resort, summer and winter, for consumptives, the uncovered thermometer has registered 166° F. by day and fallen at night to 16° F.; a "drop" of 150°.

The degree of humidity of the atmosphere is a condition of much importance. In treatment of the predisposition, or excepting cases of irritable cough, a comparatively dry air seems decidedly most favorable, as promoting free transpiration from the skin and lungs. In relation to this point, especially the exhalation of moisture from the lungs, Denison (Denver) says, "Does it not stand to reason that this transpiration of surplus vapor is a most admirable vehicle for carrying away effete matter, waste tissue and the germs of disease?" Thirst for fluids is greater, and fluids should be taken freely in a dry atmosphere.

Winds, on account of their directly cooling effect on the body, are not well borne by the susceptible consumptive, particularly moist winds. Moderate movements of air, however, are essential to good ventilation and the purification of areas of country,

as well as of dwellings. A locality somewhat sheltered from winds by forest or hill is best.

Sunshine, direct, when not too strong, is indispensable; and abundance of it is most desirable. A "sunny" climate has ever been regarded as salubrious. Herein is one of the principal advantages of mountain climate. A thin, mountain atmosphere may, however, permit Sol's rays to pass too freely and powerfully. The readiness with which the sun's rays pass through this thin dry air causes the great difference in temperature between sunshine and night.

The Oxygenic condition of the atmosphere has undoubtedly a most important bearing upon health and vigor. There appear to be important vital variations in the quality of this life-giving element, oxygen, in different localities, as well as in its quantity: variations arising doubtless through the influences of sunlight and electricity, and about which we yet know but little. To these variations is probably due, in the main and directly, the well-known different feelings, of exhilaration or the opposite, commonly experienced by persons on going from one limited locality to an adjacent one: some voicing these feelings by saying, "I feel like a different person," in such and such a place. It is not improbable that the topographical aspect—the slope, of a limited locality toward the sun, the geological structure, or the subsoil water, may through the influences of electricity and sunlight affect and change the quality of the oxygen over the place. Sir Benjamin Brodie, Doctor (now Sir) Benjamin W. Richardson and Schonbein have proved that there are at least

two distinct conditions of oxygen. Doctor Richardson has shown that warm-blooded animals become narcotized and eventually die when forced to breathe over and over again the same atmosphere, although by a process of washing, it is kept free from the toxic products now known to exist in expired air: "The process of life ceasing, not from the introduction of a poison, but as by a negation, or a withdrawal of some principle extant in the primitive oxygen which is essential to life." ("Field of Disease," etc. Phila.: Lea Brothers & Co.) By passing an electric spark through this oxygen, after it has been breathed, it acquires again its life-sustaining properties and produces no ill effects on the animals. These different states of this element Doctor Richardson distinguished by the terms vitalized and devitalized oxygen:—active and negative. It need hardly be stated that, as a rule, those places in which the oxygen is most active or vitalized are most salubrious, and most desirable as places of residence.

SPECIAL LOCAL INFLUENCES AND CONDITIONS.

The most commonly recognized special local conditions which affect the atmosphere over a locality and give rise to the noted differences, if we except those which give rise to foul air — "malaria" and other noxious gases, are (*a*) the nature of its soil, and (*b*) the slope (klima) or aspect of its surface toward or from the sun. The evaporation of moisture from the earth's surface absorbs heat; while the condensation of moisture in the air liberates heat.

Cloud or moisture in the atmosphere intercepts both the heat from the sun and that radiated from the earth's surface. It is easy, therefore, to understand that the air over a locality from which, by reason of a slope, say, toward the sun, the water of a rainfall flows freely and rapidly away, or quickly penetrates deeply into a gravelly or sandy soil, is different from that over a flat-surfaced locality with a close retentive soil, or from one sloping from the sun: not to mention many other topographic features which affect atmospheric conditions. Again, the absorption and accumulation of the sun's heat by the earth's surface soil or crust, varies not only with the nature of the soil and the slope of the surface sunward or otherwise—the angle of incidence, but also with the nature of the vegetation on the surface—trees, shrubs, grasses, etc. And again, the temperature of the subterranean water, whether manifested by warm or hot springs, or only by deep wells, affects the temperature of the soil and hence the condition of the atmosphere. Yet again, as the heating and cooling of water takes place in accordance with a law different from that by which land is heated and cooled, a lake modifies and equalizes the temperature of the air in its vicinity, making it cooler by day and warmer by night. Hence the recommendation to place a vessel of water near house plants at night to lessen the effect of cold or frost. Forests, too, produce a like modifying effect. It is well known that the temperature in forests everywhere is higher in winter and lower in summer than in the open country.

True it is that the particular air over any one locality is soon changed by the movements of air going on everywhere and giving rise to winds more or less perceptible, and is largely replaced with air from other localities. Still, when the weather is calm and there is not much atmospheric movement, the air over a given or favored place remains for a considerable proportion of the time but little changed. Besides, notwithstanding the movements, as the local topographical and geological conditions which influence and change the air are incessantly operating and producing their effects, there will always be a slight difference, as in temperature, humidity, vegetative emanations, etc., sufficient to affect electric, oxygenic, or ozonous conditions. And although these changes and conditions cannot be detected by any chemical process or instrument yet known, they may be perceptible, as already intimated, to the sensitive nervous structure of a deranged human body: or even if not sensibly or clearly perceptible by, they may yet produce effects upon, such a body.

SELECT, HOME CLIMATE.

What is usually meant by change of climate is a change to a part of the earth a considerable distance away: to a warmer or colder, moister or drier, more equable or sunny, or a more elevated climate. Moreover, the change is made apparently usually as if the climate of the country in which the consumptive had recently lived had been the cause, or this in a measure, of the consumptive condition; which it is almost needless to state, is not often, or, alone, never,

the case. It is true that in some climates it is not so easy as in others to overcome or remove a predisposition to consumption, and some tend more than others to favor the development of a predisposition: in other words, in order to prevent a predisposition, or increase of it, it is necessary to be more careful in respect to habits of life in some climates than others.

For reasons already above partly explained, two localities, adjacent and limited, may have over them an atmosphere varying in a number of important characteristics, highly favorable, or much less so, to life, health and vigor. One may, therefore, often make a most beneficial change of climate without going far from home or leaving one's native country, or even county, to which one is accustomed or acclimated. A change especially from a flat, damp, frosty soil, to a more elevated, sandy or gravelly dry one; from one much exposed to cold or damp winds and less to sunshine, to one more protected from storms and more exposed to the sun; and from an urban to a rural one, is often absolutely essential, in either prevention or cure, in consumptive cases. And such a change is in nearly all cases all that is necessary, especially on this continent above the forty-fourth parallel of latitude, inland.

A specially favored, select or ideal locality for a person predisposed to consumption, or in an early stage of it, would be one in a rather cold climate, such as northern Europe, the northern United States, above the forty-fourth parallel or higher, and Canada, presenting the following conditions or characteristics: a somewhat elevated plateau, not too flat, or a hill-

side, sloping toward the sun, with a sandy or gravelly soil and choice vegetation, as perhaps balsamic, odorous trees or plants, near a small lake, preferably between the lake and a forest-covered mountain or hill,—the latter protecting it from the severity of the usual prevailing cold winds, and with all, warm subterranean water supplying the lake. In such a place,—with such salubrious conditions, the usual seasonable or other objectionable climatic changes would be reduced to a minimum.

In the countries above mentioned there are many localities in different sections with characteristics much as just pointed out to which consumptives could resort. There need then be no leaving home and friends for distant countries: no risk from acclimatization. In the British Isles, surrounded as they are by the ocean, a sufficiently dry locality for certain cases, as with a strongly marked predisposition, is hardly obtainable. In such, notwithstanding the salubrity of sea air, a drier, more invigorating climate may be necessary. Doctor J. E. Squire says, "The influence of pure dry air, an equable temperature with bright sunshine, so beneficial to those whose lungs are weak or already damaged by tubercle, cannot be obtained throughout the year in this country, and are sought abroad by those who can afford to travel."

In concluding the general subject of climate, it may be noted that those peoples who in centuries long past migrated from the Paradisian belt, along "the snow-boundary," northward to the colder regions have developed into greater, more powerful nations than those who migrated to the warmer latitudes southward.

CLIMATE OF CANADA AND ADJACENT STATES.

The particularly salubrious and invigorating climate of Canada should be more widely known. The mean elevation of the country is only between 300 and 400 feet: less than half that of this continent, or of Europe; and oxygen abounds. It is hardly anywhere flat, but naturally well drained. The mean temperature is lower than in those parts of Europe in the same latitude. The extremes, however, of both cold and heat, are much modified by the great mid-continent lakes. The two principal seasons are Summer and Winter; the intervening seasons being shorter.

Spring is a very bright pleasant season, but of short duration, so rapidly does Summer succeed the Winter. "Leaf and blossom are not unfolded one by one; but as if by magic," when the snow is gone (Hingston).

In Summer there are rarely more than three successive days of great heat, when a copious rainfall, lasting at most but a few hours, cools, and also purifies, the air. During the hottest days, there are almost constant cool breezes, and one never suffers from the heat as do travellers in the East, or even in Southern Europe. Sunstroke is rare, practically unknown except in the largest cities. September, October, and for the most past November, constitute a delightful Autumnal or lingering-summer season, in which rainy days are not at all numerous.

The Canadian Winter, about which some persons who have little or no knowledge of it, speak disparagingly, is far from being so trying, either to health or comfort, as many suppose it to be. The cold, like

the heat of summer, while extreme in degree is not felt to be so. To persons accustomed to the damp, raw winter atmosphere of the British Isles the thermometer is a very imperfect indication of the relation to, or effects upon, the human body of the cold, yet dry, clear, sparkling, invigorating and cheering atmosphere of a Canadian winter. Even the occasional thermometric-below-zero temperature very rarely lasts more than three full days, nearly always moderating before the close of the third.

In illustration: When the sisters of St. Joseph were founding the Hotel Dieu Hospital in Montreal they lived twenty years in a building the walls of which were only a single board in thickness, and when snow fell in the night, so freely did it come in through the cracks that it had to be removed in the morning with shovels. It is related (Relat. des Jes., pub. by Govern't) that "Tender, delicate girls who feared a snowflake in France," where a "slight frost caused them to take cold," here, a "long winter, armed from head to foot with snow and ice, produces, apparently, no other effect than to keep them in good appetite." Horses and cattle in the North-west, in many instances, are not housed during winter at all, and gather their provender from the sappy twigs above, and the grass beneath, the snow which they paw aside. January, the coldest month, I have always in my experience found to be the most healthy. Indeed the winter in this temperate region is on the whole a most joyous Season. It was not of it that Homer wrote:

> ". . . Frost, which all the works
> Suspends of man and saddens all the flocks."

The spotless sheet of snow spread over the greater part of the country during several months of the year renders the air then practically germless; while the rapid vegetation of most of the remainder of the year, with the dryness of the air, or absence of great humidity, is unfavorable to so-called "germ" life. Of all known antiseptics, probably frost and dryness —desiccation—are the best.

The exhilarating influence of the air in Canada is doubtless due to its abundance of highly "vitalized oxygen." In this respect the country is hardly equalled by any other, except parts of the bordering northern States. More than a century and a half ago, Father Charlevoix wrote of it:—"We do not know of a climate in the world more wholesome; no specific disease prevails in it; the fields and woods abound in wonder working herbs; and the trees distill balsams of great virtue."

The records of the British army show that Malta has been most favorable to the health of the men, with a mortality of 1.1: Canada comes next; Nova Scotia, 1.4 and Ontario and Quebec, 1.5. In Great Britain, it was 1.7; Gibraltar, 2.1; Bermudas, 2.9; and Bengal, 5.5. It has been said that but for the use of "spirits," less necessary in the stimulating air of Canada, the mortality here would have been still lower.

Life insurance companies accept rates in this country up to a certain age lower than in Great Britain.

Canadians and natives of the most northern parts, east and west, of the United States, who become consumptive, need not go abroad for change of climate

while in the earlier stages of the disease (before the "softening" of tubercle and formation of cavities). After that time, it is in nearly all cases better to remain at home, the chances there being on the whole usually as good as anywhere, than to go abroad and die amongst strangers.

Consumptives in other countries, in the earlier stages, who seek change of climate can but rarely do better than to come to the cold, dry, bracing air of Canada. I shall conclude with the following quotation from Hingston's "Climate of Canada" (Dawsons), to which excellent book I am indebted for many of the facts given on this subject: "Indian officers have passed directly to this country, and commonly with advantage; my memory recalls many, who, having returned to Europe and had their symptoms aggravated, found that a short residence in Canada restored them to comparative comfort. Those especially who have come direct from India to Canada in autumn have noticed this change. One of my former pupils . . . became surgeon in the line and went to Bombay, where he contracted phthisis. He was sent to an elevated station . . . where he experienced temporary relief. He was then invalided and came back to Canada. In passing through Great Britain, the humid atmosphere was unbearable, and his breathing became very labored. In Canada, his breathing at once became easy. . . . He felt, so he told me, as if he were breathing, not atmospheric air, but oxygen, so refreshing and invigorating it seemed to him."

PART III.

CHAPTER XVI.

RELATING TO THE TREATMENT OF CONSUMPTION.

It is not my purpose to enter in this book into details of treatment, medical or other, nor of the symptoms and diagnosis, of confirmed cases of consumption, so far as they relate to the various special means applicable to the different stages of the disease, or the different constitutional conditions. Preventive measures, prevention of the extension of the disease, embrace the principles of what we term "cure,"—constitute the chief part, and an absolutely essential part, of it. When mischief has resulted, however, and there is actual destruction of lung tissue from tuberculization, then usually measures must be adopted or remedies applied which are never necessary before such mischief. By the time tubercle has been formed, then in most cases nutrition has been so far interfered with and deranged that, while there is no specific remedy for the tubercular condition, the functions of digestion, assimilation and excretion require special attention and management, such as supply of special nutrients,

etc.; and every individual case requires a somewhat different form or application of remedies.

Persons other than physicians may read these pages, and it would be in a measure dangerous to give here details of special remedies, or the indications for them, lest some such persons might be tempted to so treat themselves or immediate friends suffering from the disease,—tempted to apply the remedies without consulting their physician.

The proper treatment of this somewhat peculiar disease requires the utmost degree of medical knowledge, and withal, time, patience and care in applying that knowledge. Moreover, no two cases of the disease are precisely alike, and every individual case, as just intimated, requires a special line of treatment, studied out and carried out. Hence much harm may arise from any measure of self-"doctoring," and indeed not infrequently does so arise; especially from dosing with the "sure cures" advertised in the "papers."

On the contrary, what it is my purpose to give here on this part of the subject, while it may, I trust, assist somewhat the busy general practitioner who has not been able to give sufficient time to fully acquaint himself with the generally recognized views of the most recent and highest large hospital authorities respecting treatment, as indicated by the recently increased knowledge of the causes and etiology of the disease, it should rather deter anyone not a physician from running the risk of doing himself or a friend serious harm by any action in this way based on only "a little knowledge." It is in such cases where the little know-

ledge becomes the "dangerous thing": not in the *prevention* of the disease by removing and counteracting well-known causes of it.

In no other circumstances is a small amount of knowledge so dangerous as in attempts to rectify a deranged or diseased human body by any sort of medicinal treatment of it. And probably in no other disease is it so dangerous as in this peculiar and fatal one. No one thinks of applying such knowledge to a deranged or damaged watch.

DIAGNOSIS: DIFFERENTIATION.

The discerning and eminent physician, VanSweeten, was, it appears, the author of the maxim, "Qui bene diagnoscit, bene medebiter"; sometimes translated as "Diagnosis is half the cure"; but more intelligibly as, Who accurately diagnoses cases—determines their exact character accurately, will treat correctly.

Accurate differential diagnosis of consumption in the early stage requires TIME; time to make a most careful, searching, thorough examination of the patient: to (*a*) make as certain as possible as to whether the disease be really consumption or not; if consumption, to (*b*) obtain as clear a knowledge as possible of the nature and extent, or progress, of the local diseased condition and of the general constitutional effects already produced; to (*c*) learn of the special condition and constitution, history, etc., of the patient; and to (*d*) find out the probable or possible more active remote causes of the pretubercular condition. No two persons, either in health or disease, being exactly alike,

so, as stated, every case requires a somewhat different course of treatment, especially as relating to nutrients, treatment of the stomach, bowels, skin, etc.,—requires special medication: this without reference to, or aside from, the different stages of the disease. It is known that the most experienced, successful and eminent physicians, in the most extensive practice in London and other large cities, whom young and less experienced practitioners are naturally inclined to accept in a measure as examples, devote much time to the examination of each of their patients and to the consideration of the special individual states before prescribing for them: especially should this be the case in connection with consumption.

These remarks seem necessary, because sometimes with busy practitioners the temptation to make a somewhat hasty examination and diagnosis, of what appears to be a "well-marked" case, is too great to be resisted, and also because occasional cases have been treated as those of incipient consumption which were not of this nature, but which in the hands of other practitioners were found to be perhaps hydrothorax (water on the chest, in the sac formed by the two layers of the pleura): or what is worse still, occasional cases have been treated as other diseases which later proved to be tubercular consumption. Whoever makes a hurried examination is liable to mistakes of this sort: such occur for the most part only from too little time being given to diagnosis. It need hardly be added that the reputation of the physician as well as the life of the patient is at stake. As

Doctor J. E. Squire says, "Early detection of the disease being all-important, it is essential that skilled examination should be obtained. . . . And, first, we must accept the fact that the recognition of commencing tubercle in the lung is no easy matter, only possible when the chest has been skilfully and carefully examined, and the sputa, if any, microscopically investigated" (Hyg. Prevention of Consump.).

The patient is the one most interested, and in case his physician, or the one to whom he applies, appears disposed from any cause to make a hurried examination, he may very properly courteously draw attention to this point, and ask for an opinion based on a most searching investigation; accepting no other.

There are a few persons, it is true, with "very little the matter with them" who imagine they have consumption. Almost any physician to whom such may apply can usually soon convince himself that there is no consumption, or even tendency to it, in the case.

SOME SIGNS AND SYMPTOMS OF CONSUMPTION.

The general configuration and appearance of a consumptive patient, even in an early stage, with the history and certain readily obtained and common symptoms, will be at once an important guide as to probabilities, but will afford no certainty of the presence of tubercle. If after proper examination of the sputum, tubercle bacilli are recognized, unmistakably, especially if by an expert, it is presumable that there is then no question as to the nature of the disease; even although other symptoms and signs

do not strongly indicate tuberculosis. Ziemssen, however, reminds us of the old fundamental maxim, never to base a diagnosis, not even in such a case, on one single symptom. Then it will be remembered that, on the other hand, there may be pulmonary tuberculosis without the bacilli being always found in the spittle; especially in the acute miliary form and in cases in which these organisms are encapsuled—encased in fibrous tissue. Like doubt, as we know, accompanies the recognition in later stages of the true elastic fibre; it is, too, now known that pigment granules and myelin cells are found in other lung affections; and Ziemssen has shown that myodema—contraction waves of the attenuated pectoral muscles—may be produced in persons emaciated by other causes than consumption. This high authority recommends the spirometer, and also the scales, as aids in diagnosis, as well as guides during treatment. Guided by four years' experience with the former, he advises that only the relation between the volume of expired air and the stature be taken: then the spirometer serves to corroborate other symptoms. When the proportion of stature to vital capacity falls below one inch to three in a man, or one to 2.6 in a woman, he says, " we may infer a considerable disturbance of the respiratory organs," the nature of which must be learned from other symptoms.

EARLY TREATMENT: DELAY MOST DANGEROUS.

It may be laid down as a fact, indeed, a maxim, to be impressed upon both patient and physician, that the only treatment that is likely to be successful

in consumption when it is once established, is EARLY treatment. This appears to be more especially the case with this than almost any other disease. With early approved treatment, based on sound diagnosis in respect to all indications and requirements in the case, and properly carried out by the patient, there need be no anxiety or fear of the result.

To the PATIENT, to anyone who has a predisposition to this disease, and is perhaps at length awakened by some symptom of it, as loss of appetite for food, some languor and loss of strength and weight, with perhaps a little "shortness of breath" on occasions or slight cough or throat irritation, or to any friend—parent or other relative, of the same, it may be said, most emphatically, when conscious of danger, lose not a day in consulting a physician and applying the proper remedies. Don't wait in such circumstances until there is a bad cough, or pain in the chest (often signifying very little), or perhaps specks or streaks of blood come up from the lungs with very little effort or with hardly a cough at all. Go at once. The same respecting delay applies to persons who have had no marked predisposition, either hereditary or acquired, but who have had persistent cough for some weeks, whether from a "cold" or bronchial trouble, or dust or other irritation.

Self-treatment, except in so far as it relates to prevention, as given herein, may be worse, do more harm, than delay. All so-called "medicines" publicly advertised to cure consumption are, without a single exception, FRAUDS, pure and simple. However much good or virtue there may be in the "cure" or "dis-

covery," however much benefit other persons may possibly have chanced to derive from it, it is liable to do the next one much harm on account of the entirely different body constitution and condition,—liable to cause direct injury to certain body functions. It may act as a stimulant and cause a better *feeling* for a time, while the disease is progressing, perhaps fast, all the same; or it may calm or subdue a cough, when the cough, as in a measure nature's method of relief, ought not to be so subdued. I would say to all consumptives, as you value life, never be tempted, by any promises of, or apparent, benefit or "cure," to incur the risk of subjecting the delicate, deranged organs and function of your now particularly susceptible body to the influence of a compound of drugs about the nature of which you know nothing whatever, and moreover, which was originally compounded by one who could not possibly know anything whatever about your special case—your body constitution or condition. Pause, think, consider, and you will surely see the inconsistency of any such course or treatment of your case. It would be almost certain to be worse than delay. Dangerous as is delay, less harm would likely result from it than from self-treatment. It is to be hoped that the time is not far distant when those persons who seek to extract money from their suffering fellow-creatures by promises of cure through advertisements in the "press" will be subject to legal action for fraudulent practices.

To the PHYSICIAN who takes charge of a consumptive patient, or of one in whom tubercle is suspected, it may be well to say, put not the patient off with

only a tonic, a cough mixture or an alterative, for a day. At once, after due examination and consideration of the case, lay down a complete course of treatment, and impress upon the person most interested, the sufferer or his or her most immediate friend, the importance of having every detail of it carried out. Difficulties and discouragements in getting instructions fully or properly complied with are all too commonly encountered by the physician, and much tact and firmness are often required in this behalf.

INDICATIONS AND REMEDIES.

These, so far as the specific disease itself is concerned, are yet, and probably always will be, almost entirely such as are termed hygienic—physio-therapeutic—on the "lines of nature." All authorities recognize this, now, to the fullest extent, perhaps more decidedly than ever before. The proposed new remedies of scientific experimenters, all, I believe, are regarded as of only secondary importance,—as only aids, adjuncts, in the treatment. When Koch, for instance, a few years ago, introduced his tuberculin, he from the first particularly recommended that all the usual hygienic remedies—abundance of pure outdoor air, sunlight, suitable nutrition, attention to the skin, etc., be not neglected but enjoined in all cases. Without these, we can do nothing; without these, to the full extent, every other means will fail. Of all of them, pure out-door air is most important. Hence, to the now generally recognized treatment is so frequently prefixed the term "open air," "fresh air" or "out-door." As Ziemssen says, the "fresh air treat-

ment occupies first place." Many recent remarkable recoveries from tubercular peritonitis (tubercle of the serous membrane investing the bowels), apparently from simple exposure of the diseased membrane to atmospheric air by a surgical operation, seem to indicate, more clearly than ever, that the virulence of the bacillus is destroyed, even when active in the tissues, by free exposure to the air. These remarks apply to the great principle of treatment only.

Many other remedies, often indicated, in certain cases and stages of the disease, require special consideration in their application to each particular case; but as stated, cannot be discussed in this book.

A general outline of treatment may be conveniently noted under the following divisions:

First of all, it need hardly be said, all the predisposing causes of the disease, so far as they can be made out, must be removed, as far as possible, in order to prevent their further action or influence. These relate to occupation—in-door, stooping, dusty; to location—dampness, impure air; to habits of life generally—sedentary, overworked, breathing, diet, etc; and to any previous morbid body condition.

Second: An immediate important cause, apparently in all cases, being a want of full respiratory capacity, efforts must be at once made to remove this by increasing the capacity. Authorities who have given most attention to this subject recommend special lung exercises or gymnastics, or it may be "hill climbing," sometimes pneumatic chambers, for improving the respiratory function. Inhalation of oxygen, in order to supply to the tissues and fluids

a larger amount of this element, may be desirable. Some care is required that not more of this be supplied than is assimilated or used by the system.

Third: Carefully considered means must be adopted for the proper nutrition of the body, in accordance with the powers of digestion, and, not forgetting, assimilation—utilization after digestion; for which probably a certain amount of oxygen is demanded. Not only are assimilable, nutritious ordinary foods required, but not infrequently special foods—minced beef, cream or oils, malt extracts, phosphates, etc., should be provided, as the system requires, or the indications in each individual case point to.

Fourth: Attention must be given to the skin, that it may be clean and active, and so aid in a measure in the respiratory function, to relieve the lungs. While the absolute cleanliness and activity of the skin are indispensable to the best results of treatment, the cool or cold bath, in its various modified forms—sponge, hand, rain or sheet—at suitable temperatures, as present indications point to, gives tone to the entire body and lessens its susceptibility to sudden changes of temperature, and hence to "colds." Sufficient clothing, preferably light and porous, to prevent chilliness, must be worn; but not too much of it.

Fifth: Attention to deranged special, local or general functions is often necessary, even in the early stages:—of the stomach, bowels, kidneys, liver, and of the circulatory, nervous, or muscular system. The cough may require special treatment, as external applications, or inhalations. "Cough mixtures," it may be said, should never be given. In this connection

the question of exercise, active, or passive—as in massage, to be prescribed in accordance with the vigor of the individual, for improving the circulation, and through it the nervous and muscular systems, may be mentioned. As Hippocrates advised,—"the patient may take his walking exercise if walking agrees with him; if not, let him rest as much as possible." Antiseptics may be indicated. Other conditions or symptoms, such as night-sweats, hæmorrhage, diarrhœa, of advanced cases, need not be noticed here.

In conclusion, it may be observed that, the simpler and less complicated the treatment, in respect to any morbid local condition, so far as it is at all consistent with, or meets, the indications, the more successful it will probably prove to be. Any morbid action or state that has evidently been the result of the tubercular condition, will usually gradually disappear as the general body condition improves, and may usually be left in abeyance, if not excessive in degree and giving too much trouble or inconvenience: such as moderate cough, slight pains, nausea. On the other hand, any such state which has operated as a cause, may the more likely demand special treatment.

Improvement of the respiratory function will alone promote nutrition, usually in a large measure. With a suitable diet, nutrition will be still further promoted and improved. And with proper attention to the skin, improvement in the circulation and general invigoration will result. Full, deep breathing of pure sunny air, proper food, and a vigorously acting skin, constitute the trinity of treatment for consumption. Other remedies, often necessary, are quite subordinate.

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